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EXPERIMENTAL STUDIES IN GASTRIC PHYSIOLOGY IN MAN

II. A STUDY OF PYLORIC CONTROL. THE RÔLES OF ACID AND ALKALI[1]

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SINCE early antiquity the muscular intensification comprising the pylorus has engaged the attention and imagination of medical investigators. The nomenclature, from the πυλωρός of Rufus[2] of Ephesus to the "butler" of Gregory Cole, has indicated, vaguely, the nature of the pyloric action, but as with the Sphinx of Thebes, no Œdipus has appeared who has definitively solved the riddle of its control.

That this narrow muscular strip has made great appeal to the imagination of our early researchers is attested to by a consideration of this same nomenclature. The change from the simple "doorkeeper" (πύλη, gate; οὖρος, guardian) of Rufus of Ephesus to the "'just' doorkeeper" (*janitor justus*) of Galen marks the first attempt, to be repeated later, to endow the pylorus with more than perfunctory powers. The Middle Period, suspicious and ecclesiastical, disallowing the personification in "judicious" pylorus, preferred *portanarium* (*portonarius*, *portanarius*, *portunarius*, *portinarius*): obvious corruption of *portarius*—the simple doorkeeper again. The Seventeenth Century, humanizing and intellectual, brought with it the concept, developed so fully by Van Helmont, of the pylorus as *rector*, or ruler, again the gratuitous endowment of mind to matter. Writing in 1652, this author supposed the pylorus to exert an absolute power over the other gastric fibers; and to possess a power of judgment (*arbitrium*) which it exercised at will: the *rector* opened at the completion of gastric digestion not because of stimulation by the chyme, but because of its knowledge of the gastric processes. Vomiting, he explained further, was a purely arbitrary action of the *rector* and derived from its ability to differentiate between substances beneficial and inimical to the economy. As late as the first quarter of the Nineteenth Century, French investigators were still writing in the style of Van Helmont: "On objectera peut-être contre ce tact delicat que nous attribuons au pylore, sentiment exquis par lequel il exerce une espèce de choix sur les aliments qui le traversent" . . . .[3] Thus Richerand in 1825. And he says further: "Doué d'une sensibilité particulière et très delicate, le pylore peut être regardé comme une espèce de sentinelle vigilante qui empêche que rien ne passe dans le conduit intestinal, qui n'ait éprouvé les changemens convenables."[4]

[2]Authorities variously place Rufus as having lived in the period of Plato (427-347 B. C.) and of Galen (131-200 A. D.). Œuvres de Rufus d'Ephèse, Ch. Daremberg, Imprimerie Nationale, Paris 1879, preface p. 2 ff.

[3]One will object perhaps to the sensitive judgment which we attribute to the pylorus: an exquisite discrimination through which it exercises a kind of selectivity over the foods which traverse it.

[4]Endowed with a fine and very delicate sensitivity, the pylorus can be regarded a sort of vigilant sentinel that hinders from entering the intestine and from undergoing the conventional changes any food not proved beneficial.

[1]Awarded the Alvarenga Prize for 1933 by the College of Physicians of Philadelphia. Presented for publication with the permission of the College. From the Gastro-intestinal clinic of the Jewish Hospital and Roentgen Department of Graduate School of Medicine, University of Pennsylvania

In view of the paucity of established scientific facts of gastric physiology, it is not astonishing that such beliefs should have prevailed. After all, the accidental gunshot which was to inscribe the name of the American Army surgeon Beaumont in the medical Hall of Fame and to actuate the beginning of modern gastric physiology was not fired until 1822. True, the stomach tube had been used in 1812 by Phillip S. Physick.[1] This does not postulate an established use or even knowledge of the instrument, however, since historically the invention of the tube is usually credited to Adolph Kussmaul (27), born in the very year of the Alexis St. Martin incident. Even the important constituents of the gastric juice were still to be discovered: hydrochloric acid, Prout, 1824; pepsin, Theodor Schwann, 1836.

Although Beaumont authored the beginnings of modern gastric physiology, formal experimental methods cannot be considered to have been introduced until the experimental fistulas of Bossov in 1842 and Blondlot in 1843. But it remained for Roentgen to give to medicine, in 1895, the ideal method for studying gastric motility, which method was first applied experimentally by Cannon in 1897.

The results of our own experiments, to be detailed presently, it seems to us, indicate not a new concept but rather a revision of one of the oldest, since they establish the pylorus as a door—emphatically not autonomous.

Gastric motility may be considered to be the result of three components: gastric peristalsis, gastric tonus, and the state of the pylorus. It is our intention to consider briefly the first two of these components and to present experimental data, which, after analysis, cause the third component, the *state of the pylorus*, to emerge as the most important factor in gastric emptying.

EXPERIMENTAL METHOD

All studies were made on human subjects by means of roentgen examinations. The patients were completely studied in order to rule out as far as possible any organic gastrointestinal disease. Cases were selected to represent the entire range of gastric acid secretory response, from achlorhydria to hyperchlorhydria. All patients were repeatedly intubated in the clinic over a period of weeks so that psychic factors resulting from intubation were eliminated. Standard conditions for the complete study were insisted upon. No drugs were permitted. No studies were made if the patient had had any psychical disturbance during the preceding day. The evening being the best available time for the examinations, the following was the routine employed: The patient was permitted to eat his usual lunch at noon, and at 3:00 p.m., two slices of dry toast and a cup of tea without cream were ingested. Nothing was taken thereafter until 8:00 p.m., when the studies were begun.

The mouth test meal consisted of 250 cubic centimeters of lukewarm tap water containing 2 ounces of barium sulphate. All test substances in this group of experiments were added to the water and barium meal, the total volume remaining constant. The gastric emptying time for each subject under the standard conditions was determined with the water and barium meal. This was checked by a second study and rechecked at the completion of all the tests. Under the conditions outlined, we found very little variation in gastric emptying in the same individual with similar test meals. In most instances, the results were practically identical, and in the others the fluctuation did not exceed 10 per cent.

The emptying time for the water and barium meal established, new studies were made in which hydrochloric acid (0.09 to 0.53 per cent) or sodium bicarbonate (1 and 5 per cent) solutions were used. The effects on gastric motor function and on the action of the pylorus were studied serially by fluoroscopic and roentgenographic examinations. Observations and records were made during the first 5 minutes after the ingestion of the meal, the patient having been urged to drink rapidly. Records were made at 15, 30, 60, and 90, and at 120 minutes after ingestion; or at such time when complete emptying had occurred or a constant residue with the water and barium meal had been obtained.

In another group of patients, the effect of the agents was studied by applying them directly to the duodenal mucosa. Standardiza-

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tion of individual gastric emptying was determined as above. In addition, gastric motility was determined after duodenal intubation, in order to note any mechanical effect of the tube. We found *no change* in gastric motility to result from the mere presence of the tip of the tube in the duodenum and of the tube through the pylorus. Serial roentgenographic data were recorded as before.

The duodenum was first intubated with a Rehfuss tube. The test agent was then slowly instilled into duodenum while simultaneously the water and barium meal was taken. The duodenal instillation was regulated with a Murphy bulb, the rate of instillation in this series varying from 20 to 100 drops per minute.

In addition to the solutions of acids and alkalis, the effects of many other substances were studied. Included were milk and its constituents; various strengths of neutral salts; and irritants, such as pepper. This report, however, will be limited to the studies with the acid and alkaline solutions. A few of the milk experiments will be introduced, but only in so far as they are necessary to explain some of the results of previous investigators. This report is based on 176 serial X-ray examinations in the manner outlined. In order to obviate confusion, we will group our findings and then offer our explanation of the results obtained.

TABLE 1.—EFFECT OF WEAK ACID (HCL) SOLUTIONS ON GASTRIC MOTILITY

Name	Time (hrs.)	Water G.R.%	Acid G.R.%	Strength of meal Acid %	Acid response to Ewald meal
J. M.	2	25	50	0.19	Normal
H. H.	2	60	40	0.20	Normal
R. P.	2	E.	E.	0.12	Normal
A. C.	2	25	E.	0.23	Hyperacid
D. G.	2	50	70	0.18	Hyperacid
G. L.	2	30	30	0.09	Hyperacid
H. O.	2	30	25	0.15	Hyperacid
J. D.	2	E.	E.	0.13	Hyperacid
M. N.	2	20	20	0.18	Hyperacid
H. W.	2	15	15	0.16	Hyperacid
A. C.	1.5	E.	60	0.19	Anacid
G. H.	1	E.	55	0.19	Anacid
R. R.	1	E.	50	0.18	Anacid
L. M.	0.5	E.	85	0.20	Anacid
S. I.	0.25	E.	50	0.09	Anacid
C. S.	0.25	E.	60	0.12	Anacid

Time in hours—period of observation.
Water—gastric residue with water and barium meal.
Acid—gastric residue with acid meal.
E—empty.
G. R.%=gastric residue percentage.

SUMMARY OF EXPERIMENTAL DATA

Group I. Weak acid (0.09 to 0.23 per cent) taken by mouth (Table I):

A. Three patients who had shown a *normal acid secretion with the Ewald meal.* The weak acid meal produced a slight gastric motor delay in one, no change in motility in one, and a slight increase in motility in the third, as compared with the gastric emptying obtained with the standard water and barium meal.

B. Seven patients who showed a *hyperchlorhydric response to the Ewald meal.* Five showed practically no change, one registered a slight delay in motility, and one a small increase.

C. Six subjects who showed an *achlorhydric response to the Ewald meal.* All showed a marked delay which varied from 50 to 150 per cent as compared with the motility of the standard water and barium meal.

Thus the change from the water and barium meal to that of approximately 0.2 per cent hydrochloric acid evoked practically no change in gastric emptying except in patients with achlorhydria.

Group II. Strong acid (0.24 to 0.53 per cent) taken by mouth (Table II):

In this group a marked gastric motor delay was obtained in all instances, regardless of the Ewald secretory response. This delay was so marked, in most cases, that no attempt to follow through to complete gastric emptying was made. The delay was gauged by the gastric residue at the time when the standard water and barium meal had previously been emptied. Relatively, the achlorhydrics again showed the greatest changes. The following example will indicate the delay that may be produced: An achlorhydric (A.C.) emptied the standard barium and water meal in 1½ hours. The same stomach after a similar amount of 0.51 per cent hydrochloric acid still showed a gastric residue of 50 per cent at the end of 4 hours. In general, the hyperacid group registered the least relative increase in motor delay.

Group III. Sodium bicarbonate (1 per cent) taken by mouth (Table III):

A. Three patients who had shown *a normal acid secretion with the Ewald meal.* All yielded a definite decrease in the time of gastric emptying.

TABLE II.—EFFECT OF STRONG ACID (HCL) SOLUTIONS ON GASTRIC MOTILITY

Name	Time (hrs.)	Water G.R.%	Acid G.R.%	Strength of meal Acid %	Acid response to Ewald meal
J. M.	2	25	75	0.52	Normal
H. H.	2	60	80	0.53	Normal
R. P.	2	E.	40	0.49	Normal
A. C.	2	25	45	0.45	Hyperacid
D. G.	2	50	75	0.52	Hyperacid
G. L.	2	30	30	0.47	Hyperacid
H. O.	2	30	50	0.49	Hyperacid
J. D.	2	E.	20	0.49	Hyperacid
M. N.	2	20	40	0.49	Hyperacid
H. W.	2	15	40	0.49	Hyperacid
A. C.	1.5	E.	100	0.51	Anacid
G. H.	1	E.	90	0.53	Anacid
R. R.	1	E.	85	0.51	Anacid
L. M.	0.5	E.	95	0.51	Anacid
S. I.	0.25	E.	80	0.49	Anacid
C. S.	0.25	E.	90	0.49	Anacid

Time in hours—period of observation.
Water—gastric residue with water and barium meal.
Acid—gastric residue with acid meal.
E—empty.
G.R.%=gastric residue percentage.

B. Seven patients who showed *a hyperchlorhydric response to the Ewald meal.* The response was the same as in the normal group, but showed relatively a greater decrease.

C. Six subjects who showed *an achlorhydric response to the Ewald meal.* All of these registered a gastric emptying time which was identical with that obtained with the standard water and barium meal.

Group IV. Sodium bicarbonate (5 per cent) taken by mouth (Table IV):

A. Three patients who showed a *normal acid secretion with the Ewald meal.* In 2 no change in motility occurred as compared with the standard water and barium meal; in 1 a definite delay.

B. Seven patients who showed a *hyperchlorhydric response to the Ewald meal.* Six showed a decrease in gastric emptying time and in one no change was noted.

C. Six subjects who showed an *achlorhydric response to the Ewald meal.* In all of these a definite motor retardation was produced.

All members of A and B divisions showed definite delay with the 5 per cent solution as compared with the 1 per cent. In division C the degree of delay produced in most cases was comparable to that obtained in this group with the weak acid meal (Table I).

Lintvarev, as early as 1901, from experiments on dogs with gastric and duodenal fistulas, concluded that the reaction of the stomach contents had no noticeable influence upon the passage into the duodenum of the initial or "trial" portion of the meal. More recently, L. Gregory Cole (8) and others have insisted that gastric emptying begins immediately the ingested meal reaches the pylorus. This is true, provided the pylorus is relaxed when the meal arrives. In every one of our observations upon achlorhydric patients, there was an immediate filling of the cap following the ingestion of any type fluid meal. We think that this is a normal reaction in achlorhydrics in a fasting state, because, the intrinsic hydrochloric acid, responsible for pyloric closure, being absent, the pylorus is constantly patent. In most examinations in the normal and hyperacid cases immediate filling of the cap occurred, while at times several gastric waves were observed before any trace of barium was detected in this area. This was caused, we believe, by the arrival of the meal at the pylorus while this muscle was still in contraction—a state produced by the presence in the duodenum of some incompletely neutralized acid which has reached it from the fasting stomach just before the meal was administered. Inasmuch as the initial portion, on its arrival in the duodenum, serves as a test of the acceptability of the gastric contents, the Lintvarev use of the term "trial portion" is very appropriate. If acceptable, this trial portion in the cap advances, and further gastric emptying follows. However, should this portion be unacceptable, stimulation of the duodenal mucosa occurs and a reflex is activated which results in pyloric closure. This closure is maintained until the trial portion is sufficiently neutralized or diluted to permit its passage to the adjacent distal duodenum. This accomplished, pyloric relaxation takes place and further gastric emptying follows.

We do not subscribe to the opinion of Lintvarev, that the speed with which the trial portion enters the duodenum depends upon the activity of gastric contraction. We are convinced that the immediate entrance of the trial portion into the duodenum depends upon the condition of the pylorus, and not upon

gastric activity. This conclusion derives from the observations previously noted, that immediate filling of the cap and practically continuous gastric emptying may be seen in achlorhydrics after the ingestion of a bland meal, without a trace of gastric contraction.

Another phenomenon of interest was remarked when meals sufficiently irritating to set up the duodenopyloric reflex were administered. In every instance the cap alone showed filling with no progress beyond its apex for a variable time, the duration of which was in direct proportion to the strength of the stimulant involved. It will presently be shown, in the record of our duodenal tube studies, that by the application of various agents directly to the mucosa, we were able to control at will the gastric emptying.

From the facts stated, we advance that the control of the pylorus is dependent entirely upon stimuli acting on the duodenal mucosa. Normally, the stimulant is the intrinsic hydrochloric acid; however, sight must not be lost of the existence of numerous other agents,[1] added by the food, which through chemical or mechanical action can actuate this reflex. Further, that the area most sensitive to these stimuli is that portion of the duodenal mucosa just distal to the cap. From this it follows that the duodenum is the primary control in gastric emptying.

A number of questions suggest themselves from an examination of our experimental data: (1) Why should the weak acid meal produce practically no effect on gastric emptying in the hyperacid patients, an indifferent effect in those with normal acidity, and a consistent delay in the achlorhydric group?

A water and barium meal ingested by an achlorhydric presents a trial portion to the duodenum incapable of setting up any reflex. The result is an uninterrupted progress of the meal through the pylorus and duodenum. A weak acid meal, however, presents to the duodenum a trial portion which inaugurates the reflex and pyloric closure. And until sufficient neutralization of the trial portion to make it acceptable to the duodenum has been accomplished, the closure maintains. Then, the portion acceptable, it advances and pyloric relaxation ensues. Then further gastric emptying is repeated in the above sequence.

TABLE III.—EFFECT OF 1 PER CENT ($NaHCO_3$) ON GASTRIC MOTILITY

Name	Time (hrs.)	Water G.R.%	Bicarbonate G.R.%	Acid response to Ewald meal
J. M.	2	25	E.	Normal
H. H.	2	60	E.	Normal
R. P.	2	E.	E. (1¼ hrs.)	Normal
A. C.	2	25	E. (½ hr.)	Hyperacid
D. G.	2	50	E. (1 hr.)	Hyperacid
G. L.	2	30	E. (1¼ hrs.)	Hyperacid
H. O.	2	30	E. (1¼ hrs.)	Hyperacid
J. D.	2	E.	E. (1 hr.)	Hyperacid
M. N.	2	20	E. (1½ hrs.)	Hyperacid
H. W.	2	15	E. (1 hr.)	Hyperacid
A. C.	1.5	E.	E.	Anacid
G. H.	1	E.	E.	Anacid
R. R.	1	E.	E.	Anacid
L. M.	0.5	E.	E.	Anacid
S. I.	0.25	E.	E.	Anacid
C. S.	0.25	E.	E.	Anacid

Time in hours—period of observation.
Water—gastric residue with water and barium meal.
Acid—gastric residue with acid meal.
E—empty.
G.R.%=gastric residue percentage.

Is it not strange that the weak acid meal should cause such distinct and consistent gastric motor delay in achlorhydrics, yet be practically without effect when ingested by a hyperchlorhydric? Indeed, the curiousness of this phenomenon is heightened when we recollect that in the latter we are adding acid to a fasting contents already acid, while in the former no such additional acid is present. We (48) have shown elsewhere that the mechanism by which intragastric acidity is lowered is from all indications intrinsic in the stomach. Bayliss and Starling (50) have shown that the entrance into the duodenum of hydrochloric acid stimulates pancreatic secretion. Is it not possible that both the intragastric and duodenal neutralizing mechanisms, in achlorhydrics, may be less efficient than those in nor-

[1] The mechanical action of extrinsic food factors is exemplified by the reflex which is produced by changes in osmotic pressure of the ingested meal: thus, hypertonic solutions of neutral salts, of glucose, and other sugars have all proved very effective in activating this reflex, while isotonic solutions of the same substances are without any effect. Even tap water when applied directly to the duodenal mucosa is sufficiently hypotonic to cause a retardation in gastric emptying when compared to the gastric motility which results from the duodenal instillation of normal saline. Fats actively stimulate this reflex.

TABLE IV.—EFFECT OF 5 PER CENT ($NaHCO_3$) ON GASTRIC MOTILITY

Name	Time (hrs.)	Water G.R.%	Bicarbonate G.R.%	Acid response to Ewald meal
J. M.	2	25	20	Normal
H. H.	2	60	30	Normal
R. P.	2	E.	60	Normal
A. C.	2	25	E. (1½ hrs.)	Hyperacid
D. G.	2	50	5	Hyperacid
G. L.	2	30	E. (1½ hrs.)	Hyperacid
H. O.	2	30	E. (1½ hrs.)	Hyperacid
J. D.	2	E.	E. (2 hrs.)	Hyperacid
M. N.	2	20	E. (2 hrs.)	Hyperacid
H. W.	2	15	E. (1½ hrs.)	Hyperacid
A. C.	1.5	E.	40	Anacid
G. H.	1	E.	25	Anacid
R. R.	1	E.	50	Anacid
L. M.	0.5	E.	60	Anacid
S. I.	0.25	E.	40	Anacid
C. S.	0.25	E.	50	Anacid

Time in hours—period of observation.
Water—gastric residue with water and barium meal.
Acid—gastric residue with acid meal.
E—empty.
G.R.%=gastric residue percentage.

mal or hyperchlorhydric persons—a condition akin to the atrophy of disuse? It seems logical, that in achlorhydrics the absence of the normal activating stimulus has caused these mechanisms to become less responsive, while in hyperchlorhydrics the presence of an excessive acid secretion has resulted in a more highly sensitive mechanism. Our data obtained with the strong acid meals further bear out this possibility (Table II). While these meals produced definite motor delay in all three groups, those with hyperchlorhydria registered the least increased delay.

2. Why should a 1 per cent sodium bicarbonate meal yield no change in gastric motility in achlorhydrics, while a similar meal hastens gastric emptying in normal persons and in hyperchlorhydrics? Isotonic solutions of salt are unable to initiate the duodenopyloric reflex, while hypertonic and hypotonic do so readily.

In the normal and hyperacid groups the administration of the weak alkaline meal led to a partial or complete removal, at least temporarily, of the hydrochloric acid, with the result that the gastric emptying was hastened.

The second part of the question presents no difficulty if our previous observation concerning the neutralizing mechanisms has any merit. If the intragastric neutralizing mechanism in hyperchlorhydrics is most highly developed, then the addition of a relatively weak neutralizing agent should be expected to aid neutralization in such a stomach more than in one with less active inherent neutralizing resources.

How explain the effects of the 5 per cent bicarbonate meal? The 5 per cent bicarbonate meal being definitely hypertonic, its entrance into the duodenum of an achlorhydric should set up the duodenopyloric reflex. Which is precisely what happens. The trial portion upon reaching the cap instigates pyloric closure. This endures until such time as the tonicity of the trial portion has been sufficiently lowered by the diluting agents as to become acceptable to the distal area. The duodenal stimulus thus reduced permits pyloric relaxation and further gastric emptying.

In the normal and hyperacid groups, the action of the 5 per cent bicarbonate meal is similar—modified, naturally, by the stomach acid. Thus in some cases, sufficient of the meal may be rapidly neutralized in the stomach so that a solution of bicarbonate remains, which solution, on reaching the duodenum, has an action not unlike that resulting from the response to plain water and barium meal. In others, neutralization may take place, leaving a solution more nearly isotonic and resulting in an increased gastric motility. That sufficient excess of bicarbonate was universally present is obvious since there was in all cases a definite gastric motor delay, as compared with that resulting from 1 per cent bicarbonate meal.

One fact stands out clearly from these data: Without a consideration of the gastric secretory response of the experimental subjects, no logical or consistent interpretation of the results would be possible. We believe that much of the conflict in previous experimental data concerned with this problem is due to the absence of such considerations.

We have set forth the factors involved in the duodenopyloric reflex considered from the gastric approach. We present it now from the duodenal approach.

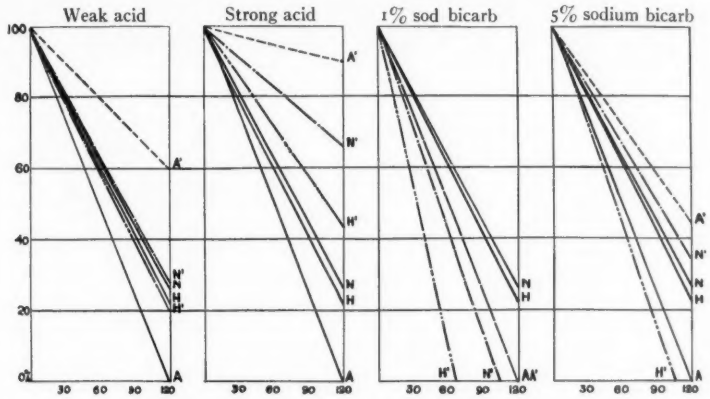

Fig. 1. Graphs illustrating Tables I to IV. Abscissæ: time in minutes. Ordinates, Percentage of gastric residue. N, Normal acidity—plain water and barium meal residue. H, Hyperchlorhydria. A, Achlorhydria. N′ H′ A′, Residue of the respective groups after special test meals noted.

THE EFFECT OF DUODENAL INSTILLATION UPON GASTRIC EMPTYING—TABLES V, VI, VII, VIII

Before proceeding, we wish to stress again the fact that the mere presence of the bucket in the duodenum and the tube through the pylorus had no effect upon gastric motility. Identical emptying was obtained with similar meals, whether or not the tube was present. Further, the effects of duodenal instillation of the various acids and alkalis on gastric motility cannot be properly interpreted without a knowledge of the test subject's gastric secretory response.

In achlorhydrics the instillation of a 1 per cent bicarbonate solution had no effect on the gastric emptying of standard water and barium meal taken by mouth—a finding which emphasizes the acceptability of such a meal to the duodenal mucosa. In the normal and hyperacid subjects a similar instillation resulted in a more rapid gastric emptying of the mouth meal. The explanation for this is obvious in the light of our previous discussion. The duodenal neutralizing mechanism in the two latter groups, enhanced by a relatively isotonic solution, itself incapable of stimulating the duodenal mucosa, would, quite naturally, be able more readily to neutralize the spurts of acid gastric contents reaching it through the pylorus. This in turn would permit of a quicker and more prolonged pyloric relaxation, thus favoring gastric emptying.

The duodenal instillation of a 5 per cent bicarbonate caused a considerable gastric delay in all cases. This solution being definitely hypertonic stimulates the duodenal mucosa: initiating the duodenopyloric reflex and prolonging gastric evacuation. Here, too, though, the gastric acid played some rôle, as evidenced by the relatively greater gastric delay produced in the achlorhydrics (Table V).

The acids similarly applied to the duodenum produced striking differences in gastric emptying in the three groups. Thus a 0.12 per cent hydrochloric acid solution introduced into the duodenum of an achlorhydric at the rate of 80 drops per minute caused a 90 per cent gastric motor delay of the standard water barium meal taken by mouth. Under similar conditions, in a patient with a high normal acidity, only a 15 per cent delay was effected. In another instance, a 0.09 per cent hydrochloric acid solution instilled at the rate of 100 drops per minute in an achlorhydric resulted in a 40 per cent gastric delay; but under similar conditions in a hyperchlorhydric caused no change in emptying of the standard water and barium meal taken by mouth. Such data lend further support to the suggestion already advanced that the duodenal neutralizing mechanism is more effective in

TABLE V.—EFFECT OF DUODENAL INSTILLATION OF WEAK ACID (HCL) SOLUTIONS ON GASTRIC MOTILITY

Name	Time (hrs.)	Intraduodenally		G.R.%	Acid response to Ewald meal
		Acid %	Drops per min.		
P. T.	1.5	0.12	80	15	Normal
H. S.	1.5	0.15	60	50	Normal
F. L.	2	0.09	100	E.	Hyperacid
F. G.	2	0.14	50	40	Hyperacid
H. R.	1	0.15	60	90	Anacid
M. H.	1	0.16	75	100	Anacid
I. J.	0.5	0.09	100	40	Anacid
H. M.	0.5	0.12	80	90	Anacid

Time in hours—period of observation.
Water—gastric residue with water and barium meal.
Acid—gastric residue with acid meal.
E—empty.
G.R.%=gastric residue percentage.

TABLE VI.—EFFECT OF DUODENAL INSTILLATION OF STRONG ACID (HCL) SOLUTIONS ON GASTRIC MOTILITY

Name	Time (hrs.)	Intraduodenally		G.R.%	Acid response to Ewald meal
		Acid %	Drops per min.		
P. T.	1.5	0.49	40	100	Normal
H. S.	1.5	0.45	30	90	Normal
F. L.	2	0.40	25	95	Hyperacid
F. G.	2	0.46	40	90	Hyperacid
H. R.	1	0.45	20	100	Anacid
M. H.	1	0.40	25	100	Anacid
I. J.	0.5	0.25	100	100	Anacid
H. M.	0.5	0.35	40	100	Anacid

Time in hours—period of observation.
Water—gastric residue with water and barium meal.
Acid—gastric residue with acid meal.
E—empty.
G.R.%=gastric residue percentage.

patients with gastric acid than in those without.

Hydrochloric acid in concentrations above 0.25 per cent introduced into the duodenum inaugurates and maintains the duodenopyloric reflex to such a degree as to cause very marked gastric delay in all the groups treated.

THE RÔLE OF GASTRIC PERISTALSIS IN GASTRIC EMPTYING

Peristalsis, so spectacular and so easily observed, is the component of gastric emptying which appealed most strongly to the imagination of our early research scholars. Galen, the founder of experimental physiology, questioned the Erasistrateans, wanting to know why it was that the stomach contracted upon the food. Seventeen centuries later the process still bears investigation! So many and conflicting are the opinions of the nature of the part played by peristalsis in gastric emptying, that its exact rôle is still to be defined.

More than 40 years ago Oppenheimer concluded that the peristaltic movements are not the primary factors in reducing the contents of the stomach. About the same time, Rossbach, from studies on dogs, reached a similar conclusion, and expressed the opinion that the pylorus, when firmly closed, could prevent the passage of even a trace of fluid into the duodenum, despite the strongest gastric contractions. In 1892, Hirsch (21) studying this problem in dogs with duodenal fistulas, failed to see the exit of gastric contents through the pylorus with each peristaltic wave. He maintained that gastric emptying took place at successive intervals of from ¼ of a minute to several minutes. Pavlov confirmed these observations and Walter Cannon's (4) roentgen studies in the cat added further support to this view.

On the other hand, Roux and Balthazard, in 1897, just antedating Dr. Cannon's publications, concluded from observations on dogs that food entered the duodenum at the completion of each peristaltic wave. This opinion has been confirmed by the results of the animal experiments of Luckhardt, Phillips, and Carlson and of Wheelon and Thomas. The studies in human subjects of McClure, Reynolds, and Schwartz, of Häneborg and of Cole (8) further support such a concept. Cole, particularly, insists that the pylorus is open during the systole of every gastric cycle and that there is propelled through its lumen into the reservoir cap a small amount of liquid chyle.

Our experiments support the view that peristalsis is not of the first importance in gastric emptying. We do believe that the gastric peristaltic wave must be a potent force in advancing the gastric contents toward the pylo-

TABLE VII.—EFFECT OF DUODENAL INSTILLATION OF 1 PER CENT ($NaHCO_3$) SOLUTION ON GASTRIC MOTILITY

Name	Time (hrs.)	Intraduodenally Drops per min.	G.R.%	Acid response to Ewald meal
P. T.	1.5	100	E. (1 hr.)	Normal
H. S.	1.5	80	E. (1 hr.)	Normal
F. L.	2	60	E. (1.5 hrs.)	Hyperacid
F. G.	2	100	E. (1 hr.)	Hyperacid
H. R.	1	50	E.	Anacid
M. H.	1	80	E.	Anacid
I. J.	0.5	100	E.	Anacid
H. M.	0.5	60	E.	Anacid

Time in hours—period of observation.
Water—gastric residue with water and barium meal.
Acid—gastric residue with acid meal.
E—empty.
G.R.%=gastric residue percentage.

TABLE VIII.—EFFECT OF DUODENAL INSTILLATION OF 5 PER CENT ($NaHCO_3$) SOLUTION ON GASTRIC MOTILITY

Name	Time (hrs.)	Intraduodenally Drops per min.	G.R.%	Acid response to Ewald meal
P. T.	1.5	60	50	Normal
H. S.	1.5	100	60	Normal
F. L.	2	100	60	Hyperacid
F. G.	2	80	45	Hyperacid
H. R.	1	50	75	Anacid
M. H.	1	50	90	Anacid
I. J.	0.5	100	60	Anacid
H. M.	0.5	100	100	Anacid

Time in hours—period of observation.
Water—gastric residue with water and barium meal.
Acid—gastric residue with acid meal.
E—empty.
G.R.%=gastric residue percentage.

rus and, when the latter is open, a potent force in gastric emptying. Were peristalsis the motivating force of pyloric opening, however, we would expect to find: (1) delayed emptying in the absence of peristalsis; (2) gastric emptying with each well defined wave; and (3) enhanced peristalsis in a normal stomach upon the induction of pylorospasm. Actually, in many instances, none of these phenomena obtains. In our own experiments we have frequently seen the barium meal literally pour through the pylorus in a steady stream without the presence in the stomach of the faintest peristaltic wave. This is often observed in achlorhydrics. We have also seen frequently, fluoroscopically, very violent gastric waves spend futile efforts against a pylorus which was actively contracted. Finally, we have never seen enhanced gastric peristalsis in a normal stomach after induced pylorospasm. On the contrary, the induction of pylorospasm is rapidly followed by a cessation of gastric peristalsis, and a return of active peristalsis is not usually seen until the agent producing the pylorospasm has been removed. Our observations suggest a reciprocal relationship between pyloric contraction and gastric peristalsis with pyloric tone as the determining factor. Our experiments indicate further, how this tone, in turn, is dependent upon conditions in the duodenum. Such a view is not without support from antecedent investigations. At the turn of the century von Moritz stated it is possible that the signal for an inhibition of gastric peristalsis originates exclusively in the intestine. More recently, Brunemeier and Carlson have shown that stimuli in the duodenum capable of producing contraction of the pylorus, induce at the same time, by local reflex mechanisms, inhibition of the tonus and contractions of the empty stomach.

Summarizing, we believe that gastric peristalsis plays an incidental part only in gastric emptying. That it is a propelling force of the gastric contents toward the pylorus we do not deny: but through the pylorus only when the latter is open. With the process of pyloric opening we do not believe peristalsis to be concerned.

THE RÔLE OF GASTRIC TONUS IN GASTRIC EMPTYING

Gastric tonus, we believe, is the force primarily concerned with gastric emptying; but its potency, too, is dependent upon the state of the pylorus. With a relaxed pylorus, gastric tonus acts as the essential emptying force. This explains the rapid motility in achlorhydrics in the absence of all peristalsis. It is also the force responsible for the rapid motility following the proper neutralization of the gastric contents in a normal or hyperacid stomach, because gastric emptying is more rapid in such stomachs even in the presence of decreased gastric peristalsis. In achlorhydrics, gastric tonus may operate unhampered if the

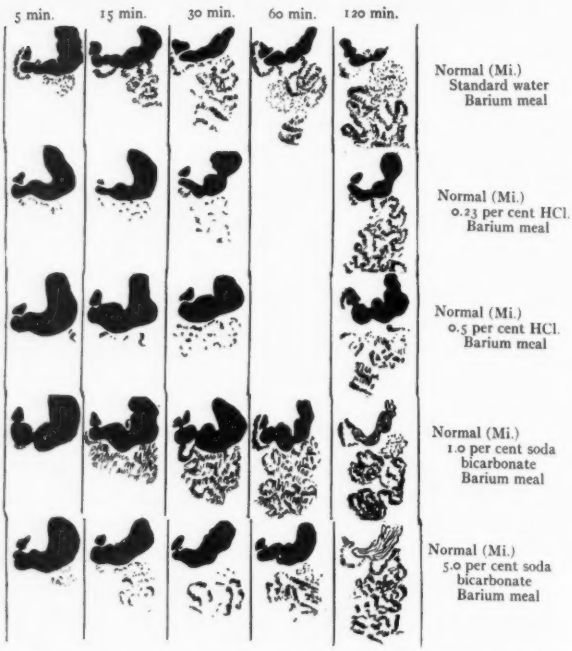

Fig. 2. Response of *normal* stomach to test substances using mouth meal.

meal administered is of such physicochemical composition as to be acceptable to the duodenum without the stimulation of the duodenopyloric reflex. Under such conditions the pylorus remains open permitting gastric tonus to exert a constant positive force in gastric emptying. With the proper neutralization in an acid stomach the duodenopyloric reflex is again abolished in part or in whole, as we have shown, thus again permitting gastric tonus to operate against a patent pylorus. It would seem that the same reciprocal relationship exists between gastric tonus and pyloric tonus as has been suggested for gastric peristalsis and pyloric contraction. Marbaix, in one series of experiments, after moderately filling a dog's stomach with milk determined the positive tension so produced. He then introduced into the upper intestine through a fistula a quantity of milk sufficient to produce pyloric closure. A new quantity of milk was then instilled into the stomach. Marbaix noted that the intragastric pressure which had been high during the introduction of the second gastric portion of milk fell rapidly. Similar results had been recorded previously by Kelling and Moritz.

ANALYSIS OF PREVIOUS LITERATURE, WITH EXPERIMENTAL DATA ON THE VON MERING REPLETION THEORY

The duodenum as a factor in the control of gastric emptying was first suggested in the early nineties when Hirsch (20) and von Mering reported their studies on dogs with duodenal fistulas. Before these investigators gastric emptying was believed to result from stimuli acting solely within the stomach. The accepted concept of the period is to be found in the splendid monograph of Poensgen, written about 10 years earlier. Investigators seemed generally to agree that the pylorus closed completely during the first period of digestion. Sooner or later, simultaneously with the increase in peristalsis, the pylorus relaxed more or less completely to permit passage of the

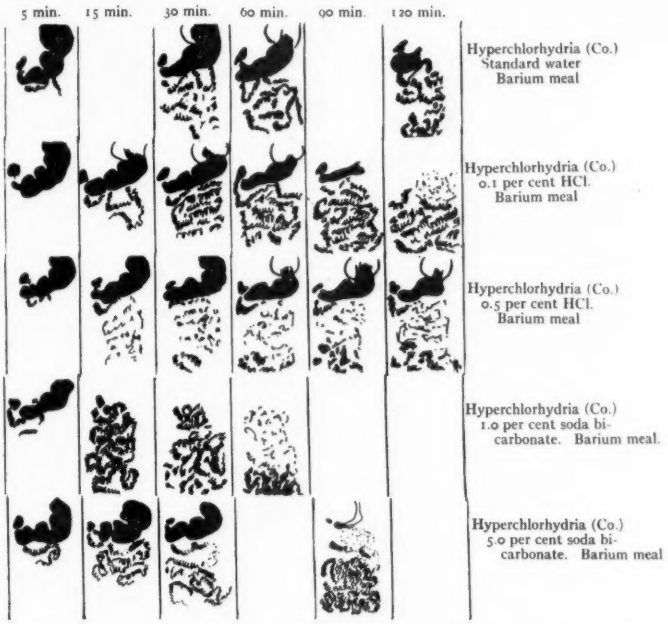
5 min.
15 min.
30 min.
60 min.
90 min.
120 min.
Hyperchlorhydria (Co.) Standard water Barium meal
Hyperchlorhydria (Co.) 0.1 per cent HCl. Barium meal
Hyperchlorhydria (Co.) 0.5 per cent HCl. Barium meal
Hyperchlorhydria (Co.) 1.0 per cent soda bicarbonate. Barium meal.
Hyperchlorhydria (Co.) 5.0 per cent soda bicarbonate. Barium meal

Fig. 3. Response of *hyperchlorhydric* stomach to test substances using mouth meal.

chymified food. Nothing definite was known of the time between the ingestion and the opening of the pylorus—a period as great as 3 hours having been suggested.

Von Mering showed from studies on dogs with high duodenal fistulas (5 centimeters from the pylorus) that the stomach emptied a standard amount of water more rapidly when the fistula was open. Under such conditions the gastric contents entering the duodenum were permitted to escape to the outside instead of remaining in the duodenum—a result easily understood from our discussions and data heretofore given.

Subsequently, von Mering introduced 250 cubic centimeters of warm milk into the duodenum through the fistula, taking 15 minutes for the operation. He then instilled into the stomach a water meal similar to those previously employed (500 cubic centimeters). His results showed that in the 30 minutes following (the time usually taken by the stomach to evacuate completely such a meal) only a few cubic centimeters of water had left the stomach. From these and similar observations, von Mering concluded very definitely that "die Anfuellung des Duenndarmes reflectorisch die Entleerung des Magens verlangsamt."[1] He thus attributes to duodenal repletion the responsibility for delaying gastric emptying. This conclusion influenced the work of Hirsch to a great extent and was supported by Marbaix and apparently by the work of Tobler. The latter was able to cause pyloric closure and a cessation of the rhythmic gastric movements by the mechanical effect of inflating a small balloon in the duodenum. Pavlov was willing, on the basis of Tobler's experiments, to accept duodenal distention as a factor in pyloric closure. We believe, however, that Walter Cannon (5) raised the logical objection to the value of Tobler's experiments as a means of interpreting normal physiology. Dr. Cannon points out that chyme normally gathers in the duodenum in a gradual manner by repeated small additions.

[1] ". . . the filling of the small intestine reflexly slows the emptying of the stomach.

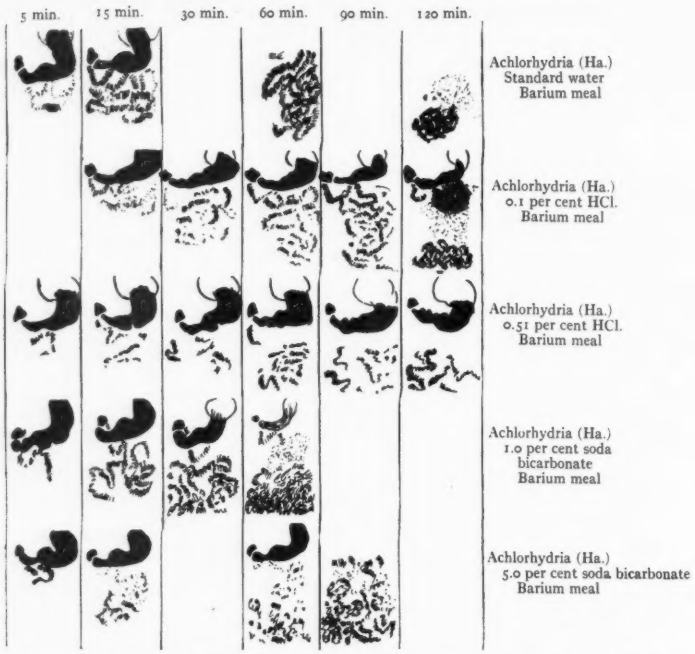

Fig. 4. Response of *achlorhydric* stomach to test substances using mouth meal.

Such material, even when accumulated, lies as a slender strand which does not distend the gut—a fact borne out in the daily experience of the roentgenologist during the course of gastro-intestinal examinations. It is obvious, therefore, that the abnormal situation produced by Tobler's balloon cannot be accepted as portraying normal conditions.

However, von Mering is not without support from recent investigators. Kaestle, Rieder, and Rosenthal, supported by the work of Cole (8), believe that the emptying of the stomach is in large measure dependent upon the emptiness of the duodenum and upper intestine.

We have performed numerous experiments with milk, cream, etc., as mentioned, and believe that our data clearly show that duodenal filling is not of any consequence normally in delaying gastric emptying. Administering by mouth a 250 cubic centimeter meal of milk and barium or cream and barium resulted in a 40 to 70 per cent gastric motor delay with the milk and a delay of over 90 per cent with the cream, as compared with the emptying of the standard water and barium meal. Delay was as marked in achlorhydrics as in patients with normal or excessive amounts of free gastric acid. The gastric delay cannot, therefore, be attributed to the mechanical effects of the rapid curdling produced in the acid containing stomachs.

The direct duodenal instillation of milk and of cream evoked a duodenopyloric reflex that was equalled only by the action of the stronger acid solutions. Thus the instillation of milk at the rate of 60 drops per minute intraduodenally resulted in a 95 per cent gastric retention of standard water and barium meal taken by mouth. At another time the instillation of milk at the rate of 30 drops per minute resulted in relatively lessened gastric motor delay. However, the substitution of table cream for milk resulted in a complete retardation of gastric emptying, while the cream was entering the duodenum. The rate of instillation of the cream had been reduced to the very slow 10 to 12 drops per minute, amounts that certainly

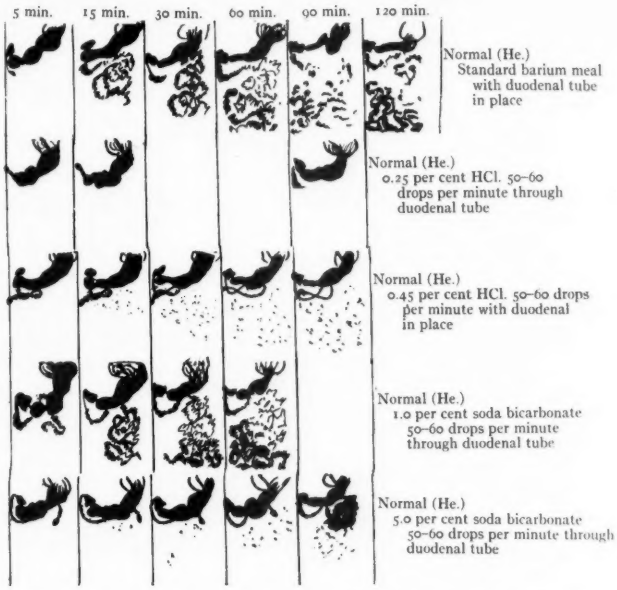

Fig. 5. Response of *normal* stomach to test substances during duodenal instillation.

could not produce duodenal repletion. In all of our tests we used Abbott's AA milk and table cream, the compositions of which show important differences only in the fat and water content. The milk has approximately 4.8 per cent fat and 86 per cent water, while the cream contains 22 per cent fat and about 70.5 per cent of water. The relationship of the fat content to gastric emptying we shall discuss in a subsequent paper. For our present purpose it suffices that the cream introduced directly into the duodenum in one-fifth or one-sixth the volume per unit of time at which the milk was introduced, produced as great or greater gastric retardation. With the differences in composition noted, it is patent that the fat content was the deciding factor in this influence. To test further for the effect of duodenal repletion we substituted normal saline, an agent which we knew was, *per se*, without effect upon gastric emptying. This was run into the duodenum at the rate of 150 drops per minute—a very rapid rate compared with the rate of the introduction of the cream. No delay in gastric emptying was observed with the normal saline experiments. Although Marbaix, in repeating von Mering's experiments, found that he was able to obtain as marked inhibitory effects on gastric emptying with much smaller quantities of milk than von Mering had used, he still attributed the reflex to intestinal filling.

In the same year (1892) that von Mering's contribution appeared, Hirsch (21) reported the first of his studies relating to this problem. It is interesting to note that both men were concerned primarily with the study of absorption by the stomach and only incidentally with the pylorus and its control. In this first publication Hirsch concludes that the liquefaction of the stomach contents is to be regarded as essential to the opening of the pylorus. In the following year he (22) reported the results of his first studies of the effect of acids and alkalis on gastric evacuation. He found that 300 or 400 cubic centimeters quantities of distilled water, or tap water, introduced into a dog's stomach were evacuated in from 10 to 20 minutes. He reported similar results with 0.35 per cent, 0.53 per cent, and 1

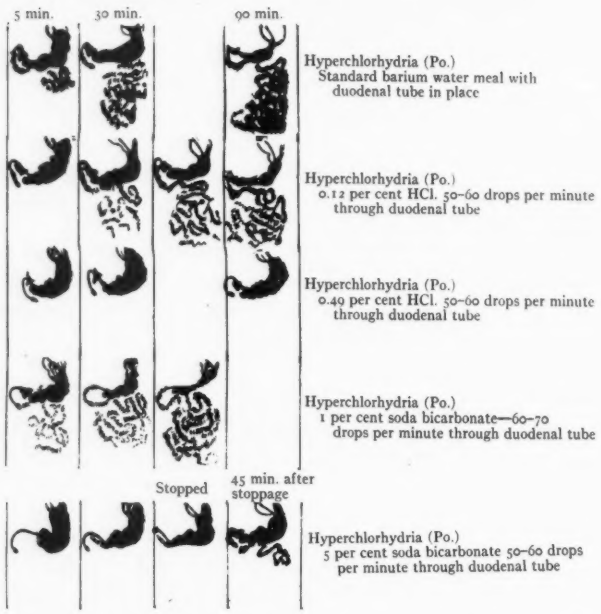
5 min.
30 min.
90 min.
Hyperchlorhydria (Po.)
Standard barium water meal with duodenal tube in place
Hyperchlorhydria (Po.)
0.12 per cent HCl. 50–60 drops per minute through duodenal tube
Hyperchlorhydria (Po.)
0.40 per cent HCl. 50–60 drops per minute through duodenal tube
Hyperchlorhydria (Po.)
1 per cent soda bicarbonate—60–70 drops per minute through duodenal tube
Stopped
45 min. after stoppage
Hyperchlorhydria (Po.)
5 per cent soda bicarbonate 50–60 drops per minute through duodenal tube

Fig. 6. Response of *hyperchlorhydric* stomach to test substances during duodenal instillation.

per cent solutions of sodium bicarbonate. But 0.1 per cent to 0.2 per cent solutions of hydrochloric acid he found were markedly retarded and still greater gastric delay was obtained with 0.3 per cent and 0.5 per cent solutions of the acid. In his acid experiments he often recovered 150 to 200 cubic centimeters more from the stomach than the amount which he had instilled. From this series of experiments, Hirsch believed that it was possible that the effects of the various strengths of acid were due more to differences in the secretion stimulated than to changes in evacuation. He concludes that the pylorus is not influenced in any way with respect to its opening and closing by alkaline, neutral, or acid fluids and that these functions cannot, therefore, be dependent upon the reactions of the fluids in the stomach. Hirsch states that it seems much more likely that the movements of the pylorus are dependent upon the movements of the stomach; the latter in their turn being dependent upon stimuli affecting the entire gastric mucosa. It is only in his succeeding article (20), in which he studies the relative rates of emptying of several inorganic and organic acids, that he concludes, somewhat abruptly, that the emptying of the stomach is influenced by the action of the acids on the intestinal mucosa.

We have discussed the contributions of von Mering and of Hirsch at some length because of their historical interest and because of the importance of their observations to our own study. Subsequent literature has referred to the duodenal effect on gastric emptying as the Hirsch-von Mering reflex. From an analysis of their reports, however, it is apparent that neither of them clearly appreciated the mechanism involved nor its importance in gastric emptying. Serdjukov, a few years after them, was the first to do so.

Working under Pavlov, Serdjukov, in his doctor's thesis, elucidated this problem to a far greater degree than either of his predecessors. He experimented with dogs which, in addition to a chronic gastric fistula, had fistulas of the pancreatic duct, of the duodenum, or of the œsophagus. He recorded 365 experi-

ments made upon 11 dogs. As a measure of gastric motility he recorded the amount of contents recoverable through the gastric fistula at a given time following the introduction of standard amounts of the test substances. These were neutral water, 0.25 per cent and 0.5 per cent sodium bicarbonate solutions, similar strengths of hydrochloric acid, and the normal gastric juice of other dogs. Serdjukov could detect no appreciable difference in the velocity with which the stomach emptied the water, acid, or alkali, although in general his impression was that the alkali drained faster.

In dogs that had in addition to the gastric fistula an external pancreatic fistula of the main pancreatic duct, decidedly different results were obtained. In these animals the acid solutions were stubbornly retained in the stomach, while the alkaline ones left very rapidly. From these experiments, Serdjukov looked upon the hydrochloric acid as the specific agent in the inauguration of the pyloric reflex. He then logically reasoned that if this were the case it should be possible to produce an artificial, prolonged closure of the pylorus by the systematic irritation with acid of the mucous surface of the duodenum. Accordingly, he introduced into the duodenum, on different occasions, both acid solutions and the acid gastric juice of another dog. He was thus able to retard the emptying of the stomach not only of the acids but also of the alkaline solutions, which normally left very rapidly. To offset any objections to his results by the argument that the gastric motor delay was due to the mechanical irritation of the duodenum during the manipulation, he repeated the experiments upon the same dog substituting a 0.25 per cent bicarbonate solution for the acid or acid juice. Such a solution produced no gastric delay. Serdjukov concluded that the alkali introduced into the duodenum through its fistula "invited," as it were, the contents of the stomach. It is unfortunate that work so well conceived and executed should have suffered because of the limitations of the solutions used. Had he not restricted himself to the concentrations of the solutions he did, he would not have been misled into believing that hydrochloric acid is the specific agent capable of initiating the duodenopyloric reflex.

Lintvarev, another pupil of Pavlov, while primarily studying this problem in its relation to the action of fats, repeated some of the above experiments. He used the gastric juice of another dog as the duodenal stimulant, in preference to the acid solutions. Lintvarev further tried to study the duration of the pyloric reflex produced by duodenal stimulation. He concluded that the reflex occurred very rapidly but diminished as soon as the acid was neutralized by the intestinal secretions and was completely eliminated in from 40 to 45 minutes. These effects were obtained after the introduction of only 25 cubic centimeters of gastric juice into the duodenum. Our own observations in human beings after an extended introduction of acid and other agents into the duodenum showed no greater prolongation of the reflex. Even after 200 to 300 cubic centimeters of the test agent had been introduced normal gastric motility was usually reestablished 30 to 45 minutes after the cessation of the instillation.

All experimental work concerned with the duodenopyloric reflex as conceived by Hirsch and von Mering came practically to a standstill at the end of the past century. The reason for this becomes apparent when we remember that it was at this time that the work of Walter Cannon began to be known and that at about this time, too, came the introduction of a new and spectacular method of investigation—the X-ray. These factors, coupled with Dr. Cannon's forceful logic, soon overshadowed all antecedent contributions to the study of the physiology of the pylorus. More recently, owing to some shortcomings in the Cannon theory, numerous studies of the effects of acids and alkalis upon pyloric action have been made. However, in regard to the action of these chemicals no unanimity of opinion has thus far been achieved.

Tabora, in 1911, investigated normal individuals with the X-ray. He studied peristalsis and the gastric evacuation time in individuals with normal, increased, and decreased acid secretions after their ingestion of bismuth broth alone, after bismuth with hydrochloric acid, and after bismuth with oil. Unfortunately, there exists no record of the strength of acid or oil that he used. His results showed a

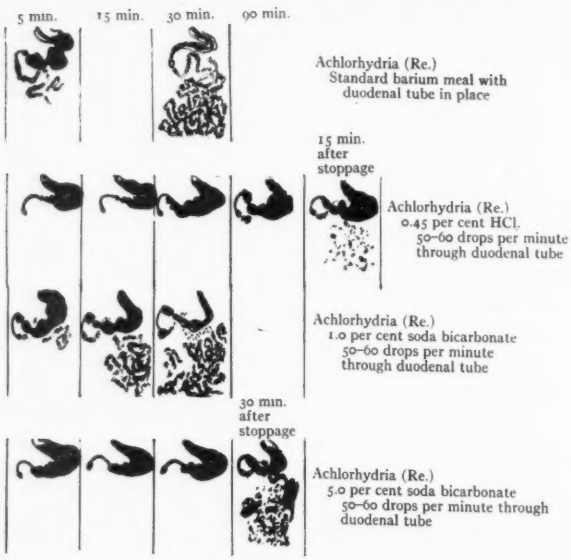

Fig. 7. Response of *achlorhydric* stomach to test substances during duodenal instillation.

marked retardation of gastric emptying after the addition of the acid to the meal. The average evacuation time was increased by about 50 per cent. During that same year, Cowie and Lyon observed gastric motor delay in infants, following the addition of acid or alkali to the meal. Ladd, on the contrary, was able to hasten gastric discharge in infants by alkalinizing the food with sodium bicarbonate. Spencer, Meyer, Rehfuss, and Hawk, determining gastric emptying in adults by means of the stomach tube, reported results similar to those of Ladd. Degener, using methods similar to those of Spencer *et al.*, achieved like results.

Interesting indirect evidence of the effect of acid on gastric emptying was obtained by Ivy from studies in water drinking in man. He noted that the stimulating power of water for the production of gastric secretion varied noticeably in different individuals. He observed further that the stomach which emptied the water quickly did not respond to stimulation by water. Finally, the work of McClure, Reynolds, and Schwartz presents the most recent serious attempt to study this problem in human beings. They observed, fluoroscopically, among other things the effect of the application of hydrochloric acid and bicarbonate of soda solutions through a tube to the antral and duodenal sides of the sphincter. They noticed no effect upon the opening or closure of the pylorus following the repeated introduction of 10 to 20 cubic centimeter portions of tenth normal hydrochloric acid on the antral side of the sphincter. Similar results were obtained with 1 per cent and 5 per cent bicarbonate. After the introduction of 20 cubic centimeters of tenth normal hydrochloric acid into the first portion of the duodenum, they recorded in two instances duodenal antiperistalsis, associated with either prolonged pylorospasm or almost complete cessation of antral peristalsis.

It is obvious from the results obtained from our experiments that McClure *et al.* failed to obtain an effect from antral applications because the small quantities of reagent which they used at any one time were neutralized or diluted before a proper concentration reached the duodenum to activate the duodenopyloric reflex.

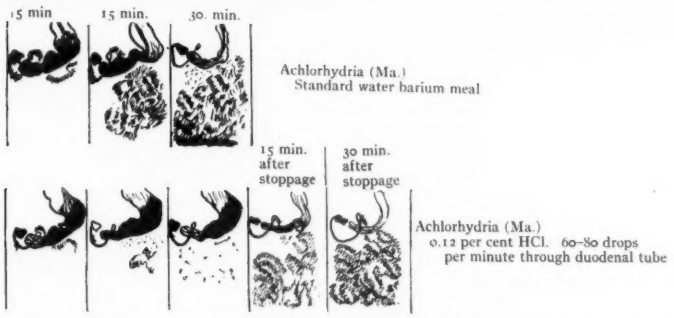

Fig. 8. Response of *achlorhydric* stomach to test substances during duodenal instillation.

The conflict of the evidence from human experimentation is not lacking in the results from animal experiments—in which latter case conditions are supposed to be more easily controlled. Just preceding Serdjukov, there appeared in France an extensive article by Marbaix. It includes an exhaustive historical review which frequently seems impertinent to the subject. But it does contain additional experimental data. Marbaix started with the supposition that the intestine influences the action of the pylorus. He attempted in his studies on dogs with intestinal fistulas to determine the extent of intestinal mucosa from which this influence could be elicited. He placed one fistula at 10 to 15 centimeters distant from the pylorus, at which level he knew he could induce the reflex. A second fistula was placed at varying points distal to the first. In 4 dogs the second fistula was located at 28 centimeters proximal to the cæcum; a little above this in the middle of the intestine about 1.3 meters from the pylorus; above the first quarter of the intestine (48 centimeters from the pylorus); and 25 centimeters from the pylorus, respectively.

In the first and second dogs the introduction of milk through the lower fistula failed of any effect upon gastric emptying. In the 2 others, however, gastric motor delay resulted when the milk was similarly applied. Marbaix concluded in this chapter that the influence of intestinal filling on the closure of the pylorus is manifest within the upper half of the small intestine. The lower half seems scarcely to possess such an effect. Marbaix states, cautiously, that he does not wish to be misunderstood as excluding all influence from the lower portion of the intestine. He is content to say that the difference in their influence upon pyloric control between the two halves of the small intestine is very marked. Marbaix, like von Mering before him, had failed to grasp the significance of the action of the *milk* in initiating the intestinal reflex and so attributed it to intestinal filling.

Likewise, we in our experiments on human beings attempted to determine the extent of the mucosa from which an influence on the pylorus could be elicited. Thus far our efforts have been but partially rewarded. By the use of long duodenal tubes we were able to reach the upper jejunum. In one instance we studied the effects of various substances introduced into the lower ileum through the ileostomy opening in a patient who had had a complete colectomy. Unfortunately, the skin surrounding the ileal opening was so sensitive that we were unable to eliminate psychic factors and their effects upon gastric motility.

In one series, in which we used as the intestinal stimulant through the long duodenal tube a 10 per cent (hypertonic) glucose solution, we obtained a 30 per cent increase in gastric residue as compared with the patient's standard gastric emptying. The glucose was instilled at the comparatively low rate of 40 drops per minute and the tip of the tube was approximately at the junction of the second and third portions of the duodenum. A similar result was obtained when the tip of the tube was in the upper jejunum. Thus far we feel justified

in the belief that the "border patrol" against the admission of the irritant lies in the region of the apex of the duodenal cap, but our intestinal intubation studies show that the reflex for pyloric closure may also be elicited by stimuli affecting the intestinal mucosa for a considerable distance beyond this area.

Certain other interesting phenomena were noted. Gaskell deduced that the pyloric sphincter has a special nerve supply different from that of the stomach and duodenum. Recent opinion (8, 31, 34), however, has inclined to the view that all of the muscle of the pyloric portion of the stomach, including the sphincter, is a single functional unit. Cole (9) was the first to advance the theory that the duodenal cap is functionally part of the stomach. Several years later, Thomas and Wheelon found that in every instance in which they obtained simultaneous records showing the effect of stimulating the extrinsic nerves to the antrum, sphincter, and first part of the duodenum, all three responded in the same way. More recently, McCrea and McSwiney have shown that the reaction of the pyloric antrum need not necessarily follow the response of the rest of the stomach to nerve stimulation, and Brown, McSwiney, and Wadge (2) were unable to obtain motor response in the pyloric antrum of the cat, even when the body of the stomach showed contraction readily. In a later study on spinal cats, Brown and McSwiney (1) were able to show marked differences in the response of the pyloric antrum and the remainder of the stomach following the administration of luminal and sympathetic stimulation. In spinal cats sympathetic stimulation caused gastric inhibition. In the spinal animal under the effects of luminal, sympathetic stimulation results in a complete reversal of the usual inhibitory reaction. The reaction of the pyloric antrum remained the same, however, under the influence of luminal. When spontaneous movements of the antrum were present, the effect of sympathetic stimulation was invariably inhibitory, differing in no way from the reactions observed in the spinal cat without anæsthetic. Many of our observations indicate that the antrum, pylorus, and duodenal cap are probably more closely related as a functional unit than is the antrum to the body of the stomach, or the cap to the adjacent duodenum. In our experiments involving the administration of the test substances by mouth, occasional instances of antral spasm as well as pylorospasm were noted with the more active reagents. This occurred, though, only in the achlorhydrics. The duodenal instillations, however, were productive of many more examples of this combined spasm which were manifested with the weaker acid solutions as well as with the 5 per cent bicarbonate. Antral spasm was obtained in this case in patients with acid secretions as well as in achlorhydrics. The antral spasm thus appears to be linked up with the duodenal reflex, but its production is apparently related to the intensity of the duodenal stimulus and to the spread of the impulse.

Returning to previous animal experimentation, we find that Schuele, a contemporary of Hirsch and von Mering, concluded from studies on duodenal fistula dogs, that sodium bicarbonate hastened the emptying of the stomach. He attributed the change in motility to the action of the liberated carbon dioxide. He grounded his opinion in the results of Kussmaul (28) that insufflation of carbon dioxide into the stomach markedly increased gastric peristalsis, and of Jaworski that carbon dioxide hastened gastric evacuation.

Morse found that water was discharged from the fasting stomach of anæsthetized pithed dogs faster than any percentage of acid. The most prominent feature he observed was the progressive diminution in the rapidity of discharge as compared with the increase in the acidity. These results are in keeping with our observations in human subjects. They fail to confirm the results of Hedblom and Cannon that acidities up to 0.25 per cent hasten motility; that 0.5 per cent acid has relatively no effect upon motility, at least during the first half-hour; and that motility is not slowed materially until 1 per cent acid meals are used. Ortner, following evacuation in dogs having a Dastre cannula in the duodenum a few centimeters below the pylorus, observed that alkaline water passed from the stomach sooner than did acid. Strong acid (above 0.3 per cent hydrochloric) distinctly inhibited the relaxation of the pyloric sphincter. Ortner

colored his test meal with methylene blue and used the appearance time of the blue color in the duodenum as a measure of the time necessary for pyloric opening. Marks, in duodenal fistula dogs, found a progressive delay in gastric emptying dependent upon an increasing acidity of the administered meal. Recently, Stewart and Boldyreff, working with gastric fistula dogs, reported that a 0.5 per cent solution of hydrochloric acid left the stomach at one-third the rate of an equal quantity of water. They found that alkalis, with the exception of weak solutions (0.5 to 1 per cent), produced marked inhibition of gastric emptying.

We have never observed in human beings the phenomena reported for dogs by Mogan and Thomas. They report as the predominant effect of hydrochloric acid in the duodenum, a decrease in the extent and constancy of the pyloric contractions. They regard this inhibitory effect upon the sphincter as probably incidental to a general inhibition of the stomach.

Elman and Rowlette studied the gastric emptying time and acidity curves in dogs in which the pyloric sphincter had been cut across and to the submucosa. They found that postoperative gastric emptying of a 200 cubic centimeter meal of 0.5 per cent hydrochloric acid was more rapid than that which occurred before the operation. That this change in motility is due to the greater accessibility of the stomach to the duodenal contents is untenable in the light of recent experiments (48). A more likely explanation is available as a result of our present studies. Applied to the data of Elman and Rowlette we should expect an imperfect response to the duodenal reflex of a sphincter muscle impaired by cutting which should, therefore, permit of more rapid gastric emptying. The beneficial effects in the treatment of duodenal ulcers, recently reported by Deaver and Burden, from resection of the anterior half of the pyloric sphincter are in all likelihood dependent upon a similar explanation, rather than upon the increased duodenal reflux, as suggested.

Of all the animal experiments reported, those of Carlson and Litt most closely parallel our results in humans. They recorded pyloric action in dogs by means of a balloon. They were also able to apply reagents to the gastric and duodenal sides of the pylorus. They found that unless the pylorus was already in hypertonus and spasm, they never failed to secure contractions of the pylorus from anything and everything that stimulated the nerve endings in the duodenal mucosa. They recorded that the stronger the acid or alkali used, the stronger and more prolonged was the induced pylorospasm. The same substances acting in the stomach caused neither relaxation nor contraction of the pylorus. Carlson and Litt also observed effects upon the pylorus from the duodenal introduction of water. This holds true in the human subject as well because we obtained a more rapid gastric evacuation of the mouth barium meal during the intraduodenal instillation of normal saline as compared with that obtained during the instillation of plain water.

SUMMARY AND CONCLUSIONS

We have indicated briefly to what extent the rôle of the pylorus has engaged the attention of medical thought even before the dawn of experimental physiology. That this interest has been maintained is reflected in the ever changing nomenclature successively applied to this muscular strip.

Our own experiments have consisted of a roentgenological study of gastric emptying and pyloric behavior in human subjects following the gastric and duodenal application of various test substances. While many reagents were studied, this report is primarily concerned with the action of acid and alkali in 176 serial roentgen examinations which indicate that:

1. Without due consideration of the individual gastric secretory response no proper evaluation of the experimental results could be made.

2. Of the three components concerned in gastric emptying, gastric peristalsis plays an incidental rôle only and is not concerned with pyloric opening; gastric tonus is the greater motivating force, but the potency of each depends entirely upon the state of the pylorus.

3. When the stomach is empty, the normal state of the pylorus is that of relaxation. This is always seen in achlorhydrics, but does not obtain in patients with free gastric acid.

4. The hydrochloric acid of the gastric contents is the natural intrinsic agent responsible for pyloric action. We do not imply, however, that it is the sole possible agent. Certain other ingested substances, such as various irritants, fats, hypertonic or hypotonic solutions of sugars and neutral salts, through their chemical or physical action are equally efficacious.

5. Any agent (intrinsic or extrinsic) becomes effective in producing pyloric closure only upon reaching the duodenum. Here a reflex is activated and maintained until proper neutralization or dilution of the duodenal contents which makes it acceptable to the adjacent distal duodenum, has occurred. Then pyloric relaxation.

6. The duodenal mucosa adjacent to the cap is most responsive to stimulation, though the response may be obtained in other portions as well. In general, the farther from the cap, the stronger the stimulus necessary to evoke pyloric response.

7. Under normal conditions, the duodenopyloric reflex is not dependent upon duodenal filling.

8. Evidence is presented suggesting that the duodenal neutralizing mechanism is most highly developed in hyperchlorhydrics and least in achlorhydrics.

9. The antrum, pylorus, and duodenal cap appear physiologically to be intimately related. Were we to picture our concept of pyloric action in a homely simile, as others have been wont to do, we would say that the stomach is like a dumbwaiter ever ready to deliver through its door, the pylorus, anything reaching it. The duodenum, however, sensitive connoisseur, is selective. If the gastric contents are acceptable to the official taster, the duodenal cap, gastric emptying continues uninterruptedly; if not, the door, or pylorus, is hurriedly closed and stays so until the portion tasted, "trial portion," is rendered acceptable. Thus, we see the pylorus as a door—emphatically not autonomous.

NOTE.—We are greatly indebted to Mr. Eugene Golomshtok of the Staff of the Museum of University of Pennsylvania for complete translations of the monographs of references 30 and 47.

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GASTRIC LAVAGE IN THE TREATMENT OF PYLORIC OBSTRUCTION

An Experimental Study[1]

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In the course of studies on the gastric secretion of cats following pyloric obstruction, daily aspiration of the stomach contents was found to be necessary. To our surprise it was observed that the animals which were subjected to repeated emptying of the stomach survived considerably longer than untreated controls. This investigation was therefore made to determine the factors responsible for the longer survival of the treated animals.

Methods. Healthy adult male or non-pregnant female cats were used. They were fed on a mixed diet of meat and milk but had fasted for 24 hours before the experiment was begun. Before operation a tube was passed, the gastric contents aspirated, and the stomach washed until clean with distilled water. Under ether anæsthesia, through a midline incision, a rubber band ¼ inch wide was passed under the duodenum between the pylorus and the common duct and was tied just sufficiently to cause blanching of the wall of the gut. The urinary bladder was then emptied by gentle pressure. The cats were placed in cages in an isolated room in order to avoid psychic stimulation of gastric secretion (2). They were weighed daily and the rectal temperature was taken. The control animals were not fed but in some of the experiments measured quantities of distilled water were offered. The vomitus was collected for 24 hour periods, though generally there was none until 36 to 48 hours after obstruction. Urine was usually expressed from the bladder daily in order not to contaminate the vomitus. The treated animals had their stomachs emptied and washed out shortly after operation and twice daily thereafter. Urine was collected at 24 hour periods. Careful notes were taken of the general condition of the cats, especially with reference to activity, dehydration, or tetany. At postmortem examination the completeness of the obstruction was verified and the stomach and bladder emptied. In one series of experiments on survival, 6 cats served as controls and 5 others were subjected to repeated gastric lavage. Determinations were made of the loss of fluid, chloride, protein, and non-protein nitrogen in the gastric contents. In another series of 4 cats, the levels of blood chloride, protein, and non-protein nitrogen were estimated before and again 3 days after obstruction. The blood was taken from the femoral artery under ether anæsthesia. These findings were correlated with the loss by way of the stomach and kidneys. The chloride was determined in the blood, gastric contents, and urine as milligrams of sodium chloride by the Van Slyke method as modified by Fiske. The protein of the blood and gastric contents was measured by the micro-Kjeldahl method of Howe, after deducting the non-protein nitrogen, which was estimated by the Folin method.

Results. Figure 1 shows the average length of life after pyloric obstruction in 5 cats which were subjected to gastric lavage twice a day in comparison with that of 6 control animals which were not so treated. Emptying the stomach and washing it out allowed the animals to live almost twice as long as those which accumulated their secretions until they vomited. In no case did a cat whose stomach was regularly emptied die sooner than the control animal.

Protocol 1. Cat 9, male, 3500 grams. Fasting 24 hours. The stomach was emptied and washed with 30 cubic centimeters distilled water. Ether anæsthesia was used. A rubber band was tied about the duodenum. The urine was expressed from the bladder. The animal was placed in an isolated cage with 100 cubic centimeters distilled water.

First day. Weight 3370 grams. Rectal temperature 98.3 degrees F. Water intake 90 cubic centimeters. Vomitus 125 cubic centimeters.

Second day. Urine 90 cubic centimeters. Water intake 20 cubic centimeters. No vomitus.

Third day. Animal was found dead in cage. Weight 3000 grams. Water intake 91 cubic centimeters. Urine and vomitus 258 cubic centimeters.

[1]From the Surgical Laboratories of the Harvard Medical School at the Massachusetts General Hospital.

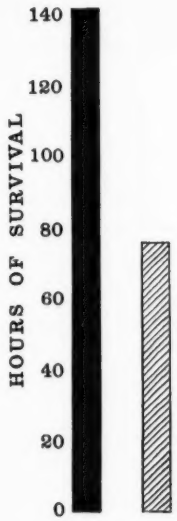

Fig. 1. The average survival after pyloric obstruction of 5 cats (solid block) treated by repeated gastric lavage as compared with the average length of life in 6 untreated animals (cross-hatching).

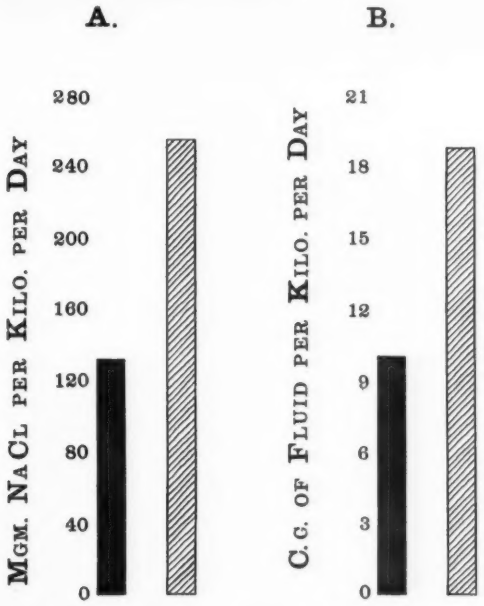

Fig. 2. The average loss of chloride (A) and of water (B) per kilogram per day after pyloric obstruction in 4 cats treated by repeated gastric lavage (solid block) as compared with that in 4 untreated animals (cross-hatching).

Postmortem examination revealed a markedly dilated stomach containing 17 cubic centimeters of fluid.

Protocol 2. Cat 10, male, 3950 grams. Fasting 24 hours. The stomach was emptied and washed with 30 cubic centimeters distilled water. Ether anæsthesia was used. A rubber band was tied about the duodenum. The urine was expressed from the bladder. The stomach was emptied and lavaged 1 hour after recovery from anæsthesia. Animal was placed in isolated cage.

First day. Weight 3900 grams. Rectal temperature 97 degrees F. Urine 45 cubic centimeters. The stomach was aspirated, 27 cubic centimeters; washed with 60 cubic centimeters distilled water.

Second day. Weight 3850 grams. Stomach contents, 90 cubic centimeters. Washings, 30 cubic centimeters.

Third day. Weight 3650 grams. Rectal temperature 98 degrees F. Urine 79 cubic centimeters. Stomach contents 27 cubic centimeters. Washings, 30 cubic centimeters. The cat was very active and ran about the room.

Fourth day. Weight 3520 grams. Rectal temperature 98 degrees F. Urine 40 cubic centimeters. Stomach contents 20 cubic centimeters. Washings, 30 cubic centimeters. Condition was even better than on day before.

Fifth day. Weight 3300 grams. Rectal temperature 97 degrees F. Urine 126 cubic centimeters. Stomach contents 8 cubic centimeters. Washings 30 cubic centimeters. Animal was very active, alert, and interested in surroundings.

Sixth day. Weight 3150 grams. Stomach contents ± 1 cubic centimeter. Not washed out. Very dehydrated. Still active.

Seventh day. Weight 3100 grams. Urine 28 cubic centimeters. Anæsthetized with ether, pylorus found tightly closed. The stomach was small and contracted, contents 4 cubic centimeters. Sacrificed.

The average loss of water and chloride per unit of body weight per day was also decreased when gastric lavage was repeatedly performed. Figure 2 illustrates the differences in the average rates of loss in 4 treated in comparison with 4 untreated animals.

The diminished rate of chloride loss was associated with a higher level of chloride in the blood. While the average fall in the chloride level in 5 untreated cats was from 677 to 444 milligrams per 100 cubic centimeters in 3.4 days, in 4 treated cats the average fall was only from 686 to 527 milligrams per 100 cubic centimeters in 4.5 days.

The body temperature during the period of dehydration after pyloric obstruction varied

only within 2.5 degrees F., generally being slightly lower at the end of the experiment.

Analyses of the nitrogen of the gastric contents revealed only small quantities of protein, 0.25 per cent in an average of 5 experiments. The non-protein nitrogen content, however, increased as the dehydration progressed. In Cat 7 the concentration increased steadily from 74 milligrams on the first day after operation to 400 milligrams per 100 cubic centimeters on the fifth day. No correlation between survival and nitrogen loss was found.

COMMENTS

It has been recognized since the work of Gamble and McIver that death after pyloric obstruction is directly referable to the loss of water and electrolytes from the body by way of the stomach. Any factor, therefore, which hastens the secretion of these substances should lead to an earlier death. It has been shown, for example, that subcutaneous injection of histamine in dogs with a pyloric fistula results in an increased rate of gastric secretion and leads to a rapid and fatal dehydration and dechlorination (1). Water itself does not stimulate gastric secretion (7). If the stomach is distended, however, the outpouring of fluid is definitely increased (7). So also is it stimulated by salts and by nitrogenous substances (7). By repeated gastric lavage in these experiments distention was prevented and any incitants of secretion were removed. The loss of chloride and water was thereby reduced (Fig. 2) and life prolonged in the treated animals (Fig. 1).

Gastric lavage has been used clinically for some years. The work of Wangensteen has placed great emphasis upon the comfort and relief from distention and vomiting to be obtained from drainage of the stomach by the nasal tube. He states that "it has been remarkable how the patient's condition, as well as his comfort, improved incident to the interruption of accretion in distention" (9). The results obtained in these experiments would seem to indicate that the improvement in general condition after gastric lavage was due at least in part to a reduction in the rate of loss of water and electrolytes from the body into the lumen of the stomach.

CONCLUSIONS

1. The period of survival in cats with complete pyloric obstruction is almost doubled by frequent aspiration of the stomach contents.
2. There is a concomitant decrease in the rate of loss of chloride and water in the treated animals.
3. The loss of protein by way of the stomach is quite small.
4. Dehydration from pyloric obstruction in cats is not associated with an elevation of body temperature.
5. It is suggested that in clinical cases the benefit derived from gastric lavage is to be attributed in part to the decrease in the rate of loss of chloride and fluid from the body into the stomach.

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II. THE DETERMINATION OF THE WEIGHT AND AGE OF THE FETUS *IN UTERO* BY THE AID OF STEREOROENTGENOMETRY[1]

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IN the first study of this series a method of X-ray measurement was described that gives reliable information as to the occipitofrontal diameter of the fetal head *in utero*. It is the scope of the present communication to present means whereby this occipitofrontal diameter may be translated into the practical terms of fetal age and body weight.

Scammon and Calkins have established "the law of uniform fetal growth ratios" which states that during the fetal period linear growth of the various parts of the body takes place at a uniform rate. In their studies they have calculated the growth of the occipitofrontal diameter (by empirical formula) with respect to age in the fetal period. This relationship is presented in Figure 1 so that from a given occipitofrontal diameter the age of the fetus *in utero* may be stated in lunar months.

While this information is of considerable interest it helps but little in enabling the obstetrician to visualize accurately the size of the fetus *in utero*. An attempt has been made, therefore, to translate the significance of the occipitofrontal diameter into the comprehensible terms of body weight. The relation existing between the occipitofrontal diameter and birth weight has been investigated in 479 newborn infants and is expressed in the accompanying graph (Fig. 1). Curves have been constructed by inspection for the estimation of the minimum, average, and maximum body weight to be expected for any given occipitofrontal diameter. Table I has been compiled from this data and gives the same information.

Knowledge as to the size of the fetus *in utero* has proved to be of particular value in cases complicated by toxæmia, heart disease, bleeding, or any other condition that might necessitate an early termination of pregnancy. Brief summaries of a few case histories are presented at this point that illustrate the application of this service to specific obstetrical problems.

CASE 1. A 27 year old primipara was examined in the eighth month and immediately sent into the hospital because of vaginal bleeding. She had had painless bleeding for the preceding 2 days and had passed about a quart of blood. On admission she was in good condition and was not bleeding.

Stereoroentgenometric examination found the fetal occipitofrontal diameter to be 11.5 centimeters. This indicated a minimum fetal weight of 5 pounds (2,267 grams) and a probable weight of 6 pounds 12 ounces (3,075 grams).

Three days after admission vaginal examination established the diagnosis of placenta prævia and started some fresh bleeding. A cæsarean section was performed immediately under gas, oxygen, and ether anæsthesia with the delivery of a 5 pound 12 ounce (2,625 gram) infant whose actual occipitofrontal diameter was 11.6 centimeters. Both mother and infant were discharged later in good condition.

CASE 2.[2] This patient had lost her first child and her second pregnancy resulted in a miscarriage at 2 months. She developed toxæmia and chronic nephritis during her third pregnancy and although she went to full term a small macerated fetus was precipitated. From the third month of her fourth pregnancy she showed a slight trace of albumin in the urine but the blood pressure stayed within normal limits until later. The question of a therapeutic abortion was considered but as the patient was extremely anxious to have a child pregnancy was allowed to continue.

An X-ray determination of fetal size was made in the seventh month and the fetal occipitofrontal diameter found to be 9.9 centimeters. This indicated a minimum fetal weight of 3 pounds (1,360 grams) and a probable weight of 3 pounds 8 ounces (1,600 grams).

Because of the small size of the fetus and because the maternal condition permitted, pregnancy was allowed to continue for another month. By that time the blood pressure was found to have risen to 134/90 and a large trace of albumin had appeared in the urine. The X-ray examination was repeated and the occipitofrontal diameter now found to be 11 centimeters which meant a minimum fetal weight of 5 pounds (2,267 grams) and a probable weight of 6 pounds 12 ounces (3,075 grams).

Labor was induced and the patient delivered a 6 pound 2 ounce (2,778 gram) infant with an actual occipitofrontal diameter of 11.1 centimeters.

[2] I am indebted to Dr. Paul Gustafson for permission to report this case.

[1] "Studies on the Reduction of the Newborn Infant Death Rate" from the Boston Lying-in Hospital, the Departments of Obstetrics and Pediatrics of the Harvard Medical School and the Department of Child Hygiene of the Harvard School of Public Health. Part of a communication originally read before the Boston Obstetrical Society on October 18, 1932.

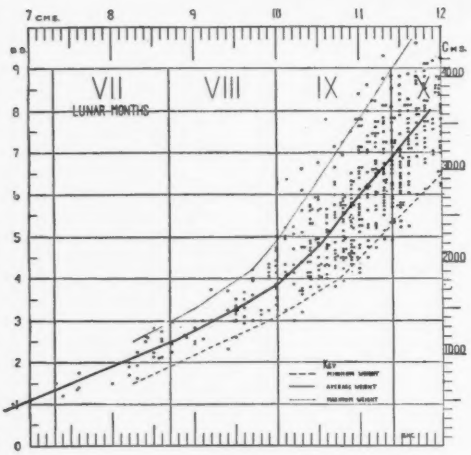

Fig. 1. The relation between the occipitofrontal diameter and birth weight as observed in 479 newborn infants. The relation between the occipitofrontal diameter and fetal age is derived from the studies of Scammon and Calkins.

Pathological examination of the placenta showed a partial premature separation and an œdematous umbilical cord. Microscopically the placenta presented the picture associated with chronic nephritis, hæmorrhage into the decidua and fetal arteritis.

CASE 3. A 26 year old ii-para had been delivered previously by cæsarean section because of a compound presentation and a question of disproportion. She was found to have rheumatic heart disease with mitral stenosis and paroxysmal auricular flutter. In the eighth month of her pregnancy she was discovered to be fibrillating. She was examined by X-ray and the fetal occipitofrontal diameter demonstrated to be 11.3 centimeters. This indicated a minimum fetal body weight of 5 pounds (2,267 grams) and a probable weight of 6 pounds 12 ounces (3,075 grams). Delivery was accomplished by cæsarean section under drop ether anæsthesia. The infant actually weighed 6 pounds 10 ounces (3,000 grams) and had an occipitofrontal diameter of 11.3 centimeters.

CASE 4. A 25 year old primipara was admitted to the hospital in the seventh month of pregnancy with the diagnosis of chorea. The cardiologist advised delivery as soon as the baby was believed to be viable. By X-ray examination the fetal occipitofrontal diameter was found to be 10.6 centimeters. This indicated a minimum fetal weight of 4 pounds (1,814 grams) and a probable weight of 5 pounds 8 ounces (2,500 grams). The patient was delivered from below of a 5 pound 12 ounce (2,600 gram) infant whose actual occipitofrontal diameter was 10.9 centimeters.

Certain interesting figures have been obtained concerning the rate of increase of fetal body weight that are in accord with existing clinical impressions. In the seventh and eighth lunar months the fetus slowly increases in weight at the rate of 5 and 6 ounces per week, respectively. During this period the total body weight of the fetus increases from a little over 1 pound (600 grams) to 4 pounds (1,800 grams).

In the last 2 lunar months of pregnancy the fetus begins to increase in weight at a much more rapid rate while at the same time maintaining the previous rate of skeletal growth. This increase in weight is due to the laying down of large deposits of subcutaneous fat and water and increase in muscular development. The rate of increase in weight jumps to between 8 and 12 ounces per week. Appreciation of this rate of weight gain is of great obstetrical importance for it means that even a 2 weeks' delay in the induction of labor will result in an increase in fetal weight of from 1 to 1½ pounds. In this connection it may be of interest to point out that whereas in our experience the mortality rate for infants of less than 5 pounds has been between 48 and 29 per cent, the mortality for infants of from 5 to 6 pounds has been less than 3 per cent.

Fortunately, in the group of infants of greatest interest from the point of view of their degree of maturity a close relationship was found to exist between body weight and occipitofrontal diameter. In infants of a body weight less than 4 pounds (1,800 grams) it was possible to predict their actual weight from an estimated occipitofrontal diameter with reasonable accuracy. In the series investigated, all infants with an occipitofrontal diameter of less than 10 centimeters were found to weigh less than 4 pounds (1,800 grams). Those with a diameter between 8 and 9 centimeters were found to weigh less than 3 pounds (1,360 grams). Those whose diameters were below 8 centimeters were all non-viable.

There were such wide variations of possible weights encountered above and below the mean expected body weight curve in the last 2 months of pregnancy that it was impossible to give an accurate prediction of the birth weight to be expected in the individual case. It was possible, however, to predict the

minimum weight that might be encountered for any given occipitofrontal diameter and at the same time give the average or probable weight to be expected. In these latter months to be assured of the minimum weight that might be encountered in an individual case is of great practical importance in enabling the obstetrician to choose the safest course of action. In the group investigated an occipitofrontal diameter of 10.5 centimeters assured the obstetrician of an infant weighing at least 4 pounds (1,800 grams) while a diameter greater than 11 centimeters indicated a body weight of at least 5 pounds (2,267 grams).

The occipitofrontal diameter may be assumed to increase *in utero* at the rate of from 10 to 12 millimeters per month. Thoms has found that in heads with an occipitofrontal diameter up to 11 centimeters the biparietal diameter may be obtained by subtracting 1.5 centimeters.

The determination of fetal size has been of considerable value in the handling of cases complicated by any condition—such as toxæmia, heart disease, or bleeding—that might necessitate an early termination of pregnancy. It is a great comfort to be assured of the viability of the baby prior to the premature induction of labor or delivery by cæsarean section. Many times in the course of our studies when a small fetus has been revealed by X-ray examination the maternal condition has permitted a prolongation of the pregnancy, thus greatly increasing the infant's chances of living. On the other hand, it has been found even more frequently that when the examination is made the fetus is already of sufficient size that a further prolongation of pregnancy, with its considerable hazard to both the mother and infant, is unnecessary.

TABLE I.—A TABLE FOR THE PREDICTION OF THE MINIMUM AND AVERAGE BODY WEIGHT TO BE EXPECTED FROM A GIVEN OCCIPITOFRONTAL DIAMETER

Occipitofrontal diameter in centimeters	Expected body weight			
	English system		Metric system	
	Minimum lbs.—oz.	Average lbs.—oz.	Minimum grams	Average grams
11.5–12.0	6 0	7 12	2727	3525
11.0–11.5	5 0	6 8	2267	2950
10.5–11.0	4 0	5 4	1814	2400
10.0–10.5	3 0	4 4	1360	1900
9.5–10.0	3 0	3 8	1360	1600
9.0– 9.5	2 8	3 0	1150	1360
8.5– 9.0	2 0	2 8	907	1150
8.0– 8.5	1 8	2 2	700	1000

CONCLUSIONS

1. A graph has been prepared, based on a study of 479 infants, from which it is possible to estimate the weight and age of the fetus *in utero* from the stereoroentgenometric determination of the occipitofrontal diameter of the fetus.

2. Data has been presented which suggests that the fetus gains weight *in utero* at the rate of 5 to 6 ounces per week during the seventh and eighth lunar months and at the rate of from 8 to 12 ounces per week during the last 2 months of pregnancy.

3. The determination of fetal size has proved to be of value in the management of cases complicated by toxæmia, heart disease, bleeding, or any other condition that might necessitate an early termination of pregnancy.

4. Through a knowledge of fetal size many pregnancies that might otherwise be terminated immediately may be prolonged until a viable infant is assured.

5. An X-ray examination revealing an infant already of adequate size may make it unnecessary to expose the mother to the hazards of a further continuance of pregnancy and the fetus to the associated danger of intrauterine death.

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THE GRADING OF EPIDERMOID CARCINOMA

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THE pathological material of the Huntington Memorial Hospital and the Massachusetts State Tumor Diagnosis Service has been unusually rich in epidermoid carcinomata. Since formal histological grading of malignancy was first developed for this group of tumors (1) and even now is most successfully applied to them, a study of our material should prove of value.

Since the opening of the hospital in 1912, 5,052 separate epidermoid carcinomata have been diagnosed in the laboratory. Many of these had more than one biopsy, but the duplicates have been eliminated. There was practically no variation in grade between subsequent biopsies on the same tumor.

These 5,052 cancers were removed from 4,987 patients, there being 35 cases of multiple epidermoid cancers. In addition to these 35 cases, there were 24 with one epidermoid cancer and one or more cancers of other types. Five of the multiple cases showed 3 or more distinct lesions. The 5 multiple cancer cases which came to autopsy have been discussed in our previous report (9). Undoubtedly, other multiple cases occurred in the series, although not known to us, as the biopsy material was not sent to this laboratory.

Our system of grading has been described elsewhere (7). In essence it parallels Broders', but we use three grades rather than four.

While many tumors are fairly uniform histologically throughout, thus making grading fairly easy, others vary. We have arbitrarily chosen the least differentiated portion on which to grade, never less than one-third, but make allowance for the presence of a higher degree of differentiation elsewhere in the tumor. We feel that the grade should be determined from the least differentiated portion of the tumor, rather than the whole, since any practical value of grading rests on the clue it gives to the subsequent behavior of the tumor. This tends to be determined, at least in epidermoid carcinoma, by the most active portion.

Cellular differentiation is undoubtedly the most important point to be considered. We believe differentiation of the type cell of the epidermoid carcinoma to parallel chiefly the degree of keratinization. However, in addition to this point, increase in mitotic activity, and particularly the presence of abnormal mitoses; increased variation of cell size and shape; increased tendency to infiltration of the tissues, all indicate higher degrees of malignancy. Stromal changes we regard as without significance in determining the grade. Usually marked lymphocytic infiltration occurs in the lower grades of cancers, although this is by no means constant. Eosinophilic infiltration is most probably determined by the extent of necrosis of lymphocytes.

We have not endeavored in this study to differentiate between the various types of keratinization. It is not sufficient to lay down one arbitrary pattern for grading. It must be adapted for the tissues of each locality, with due regard for the character of the normal epithelium of the part. Thus an epidermoid cancer of a given grade is more heavily keratinized in the lip than the tongue, the vulva than the cervix uteri.

The slides were studied and graded by each of us individually, and then checked and compared. Some, either because of scanty biopsy material, poor technical treatment, or extraordinary variability in histological appearance, could not be satisfactorily graded. These made up only 2 per cent of the total.

HISTORICAL SUMMARY

While grading was originally developed as an aid to the prognosis of individual cases (1), there has been an increasing tendency, even among its advocates, to decry too close correlation between the grade of malignancy and the end-result in any given case. However its value in establishing group prognosis has yet to be seriously challenged. In certain types of tumors, to be sure, its accuracy is distinctly less than in others, and

TABLE I.—RELATIVE FREQUENCY OF GRADES IN VARIOUS SITES

		Grade I		Grade II		Grade III		No.	Totals
		No.	Per cent	No.	Per cent	No.	Per cent		
Skin, head, and neck	♂	279	65	119	28	30	7	428	607
	♀	124	69	44	25	11	6	179	
Skin, covered body surfaces	♂	37	69	15	28	2	3	54	110
	♀	33	58	14	25	9	17	56	
Skin, hand, and foot	♂	90	85	15	15			105	149
	♀	40	90	4	10			44	
Lower lip	♂	441	76	122	21	14	3	577	594
	♀	12	60	5	40			17	
Buccal cavity	♂	438	52	312	37	93	11	843	970
	♀	67	52	47	37	13	11	127	
Respiratory tract	♂	52	46	43	38	18	16	113	142
	♀	11	38	10	34	8	28	29	
Œsophagus	♂	18	29	34	55	10	16	62	83
	♀	7	33	10	48	4	19	21	
Unusual sites	♂	4	25	11	69	1	6	16	40
	♀	10	42	9	37	5	11	24	
Genitalia	♂	28	56	17	34	5	10	50	1639
	♀	430	27	799	53	360	20	1589	
Urinary tract	♂	4	16	4	16	17	68	25	47
	♀	5	22	5	22	12	56	22	
Totals	♂	1391	61	692	30	190	8	2273	4381
	♀	739	35	947	45	422	20	2108	
		2130	49	1639	37	612	14	4381	

Note: This table does not include cases with data as to site, sex or age missing.

in some no satisfactory means of grading has yet been evolved.

In the group of the epidermoid carcinomata, however, there has been fairly uniform success attained by those who have made use of the methods of histological grading. Of marked importance, in the group of the epidermoid carcinomata in particular, has been the growing tendency, emphasized by Ewing, to regard grading as having significance not only from the standpoint of end-results, but also from that of immediate treatment. It seems quite clear that the radiosensitivity of a tumor increases as its grade of malignancy increases. One must be careful not to confuse radiosensitivity with what we may term radiocurability. For example, certain of the grade III carcinomata of the cervix uteri melt away with striking rapidity under radium treatment but recur very promptly and kill in a relatively short period of time in spite of treatment. Practically every case of grade III carcinoma of the cervix that we had an opportunity to follow recently has shown an immediate response to radiation with apparent complete or nearly complete disappearance of the local growth, followed by prompt recurrence and usually metastasis.

As is natural in the attempt to perfect none-too-well functioning systems, there have been many modifications of the criteria used in the grading of tumors and various factors have been introduced which may or may not be of importance in determining the grade of malignancy. In our experience, the more complicated methods have not proved of any greater value than the simpler ones. Thus we have graded a small group of tumors reported here by Hueper's system and have not found significant variation from the results obtained by our own less cumbersome method of estimation of malignancy.

While various groups of tumors are still regarded with uncertainty when it comes to assignment of histological degree of malignancy, none the less in most of the epidermoid carcinomata it is now generally believed possible to make a fair approximation of the grade (3). In this, due consideration must be given the various clinical factors as well as the picture of pathological malignancy before any attempt is made at prognosis, bear-

TABLE II.—RELATIVE FREQUENCY OF GRADES BY AGE

		0–9		10–19		20–29		30–39		40–49		50–59		60–69		70–79		80+		No.	Per cent	Total
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent			
Grade I	♂	1	.1	8	.9	18	2.0	90	10.0	195	22.0	314	35.0	230	26.0	35	4.0	9	1.0	900	76	1185
	♀	2	.7	3	1.0	13	5.0	27	9.0	59	20.0	75	26.0	84	29.0	20	7.0	2	.7	285	24	
Grade II	♂			3	.6	16	3.0	51	10.0	113	22.0	180	35.0	125	24.0	25	5.0	2	.4	515	80	643
	♀			5	4.0	7	5.0	16	12.0	26	20.0	38	30.0	27	21.0	9	7.0			128	20	
Grade III	♂	1	.7			4	3.0	18	13.0	40	28.0	55	38.0	22	15.0	4	3.0			144	76	190
	♀	1	2.0	2	4.0	4	9.0	9	20.0	14	30.0	10	22.0	4	9.0	1	2.0	1	2.0	46	24	

TABLE III.—CANCER OF THE CERVIX UTERI BY AGE AND GRADE

Grade	Total	20–29		30–39		40–49		50–59		60–69		70–79		80+	
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
I	351	13	4	52	15	102	29	114	32	56	16	13	4	1	.3
II	741	11	1	106	14	246	33	234	32	108	15	34	5	2	.3
III	330	14	4	59	18	97	29	93	28	56	17	11	3		

ing in mind that the grading will of necessity be always uncertain so far as individual application goes, even though it may be of very definite value from the standpoint of group prognosis, and still more so from the standpoint of determining relative susceptibility to radiation of the various cancers which may be encountered in a given site.

THE RELATIVE FREQUENCY OF GRADES IN VARIOUS SITES

Through our attempts to correlate the criteria used in histological grading with the picture normally presented by the epithelium in each part, we feel that Table I offers fairly comparable data. In it we have endeavored to present the relative frequency of the various grades of malignancy for a given site as encountered in our material.

Thus it will be seen that in epidermoid cancers of the external surface of the head and neck, grade I tumors outnumber grade III ten to one. This closely parallels clinical experience with these tumors, the bulk of which do well under treatment, rarely metastasize, and even then are practically restricted to the regional nodes. Moreover, relatively large doses of radiation are required to effect disappearance of these tumors, the low grade paralleling radioresistance. In the hand and foot no grade III cancers were encountered among 149, and only 13 per cent belong in grade II, again in keeping with their low clinical malignancy.

In the lower lip (including unspecified lip cases, practically all of which are probably lower) the relatively benign character of the lesions is even more striking. This further emphasizes the fact that most failures in the treatment of lip cases are caused either by initial delay or inadequate treatment.

The buccal cavity presents a strikingly different picture. Here only half the cases fall in grade I, although a lesser degree of keratinization was exacted for this grading than in the external cancers. In the respiratory tract a similar ratio prevails.

The cervix uteri presents an even more marked reversal of these relationships, grade III being as frequent as grade I, and grade I making up only one-fourth of the total. This again would be expected in view of the clinical behavior of cervical cancer and the frequency of generalized metastases, which are far more common in this than in the other groups mentioned (8). True, it may be objected that the facial and lip cancers have a more clearcut lymphatic barrier to hurdle before reaching the viscera, but none the less this is by no means impenetrable, as the melanomata of the face and scalp prove only too well.

TABLE IV.—DISTRIBUTION OF EPIDERMOID CARCINOMATA BY GRADE, SITE, AND SEX

		Grade I		Grade II		Grade III		Totals		
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	
Skin, head, and neck	♂	279	69	119	73	30	73	428	71	607
	♀	124	31	44	27	11	27	179	29	
Skin, covered body surfaces	♂	37	53	15	52	2	18	54	49	110
	♀	33	47	14	48	9	82	56	51	
Skin, hand, and foot	♂	90	69	15	79			105	70	149
	♀	40	31	4	21			44	30	
Lower lip	♂	441	97	122	96	14	100	577	97	594
	♀	12	3	5	4			17	3	
Buccal cavity	♂	438	87	312	87	93	88	843	87	970
	♀	67	13	47	13	13	12	127	13	
Respiratory tract	♂	52	83	43	81	18	69	113	80	142
	♀	11	17	10	19	8	31	29	20	
Œsophagus	♂	18	72	34	77	10	71	62	75	83
	♀	7	28	10	23	4	29	21	25	
Unusual sites	♂	4	29	11	55	1	17	16	40	40
	♀	10	71	9	45	5	83	24	60	
Genitalia	♂	28	6	17	2	5	1	50	3	1639
	♀	430	94	799	98	360	99	1589	97	
Urinary tract	♂	4	44	4	44	17	59	25	53	47
	♀	5	56	5	56	12	41	22	47	

A uniform division of the number of cases in a given grade is not essential, and indeed should not be expected. We believe that the lower grades of malignancy predominate in some sites, and the higher grades in others, and that this variation may explain in part the varied clinical behavior of cancer in different localities.

AGE AND GRADE

There is a widespread and well founded impression that cancer in young people is a much more virulent disease than in the elderly. Whether this rests on properties of the growths themselves or of the host is not clear, and a comparison of relative frequency of the grades of malignancy at different ages is definitely indicated. Should grade III cancers predominate in the young the question would be at least partly answered.

However, study of our material disappoints us. Regardless of the location of the tumor, the relative frequency of the grades remains the same in each age group. Thus males under 40 years of age had 4.4 per cent of the grade I cancers of the skin of the face and head, 7 per cent of the grade II, and 3 per cent of the grade III. Similarly in cancer of the mouth, males under 40 years of age had 1.7 per cent of the grade I cancers, 2 per cent of the grade II, and 3 per cent of the grade III. Males 80 years of age or over presented 10 per cent of the grade I face cancers, 12 per cent of the grade II, and 3 per cent of the grade III group. The same insignificant variations are shown in cancers of other sites.

Combining several of the important sites in Table II (skin of the face and head, trunk, hands, and feet; and other scattered sites), a surprising similarity of frequency in the various age groups is shown in all three grades, whether the sexes are considered separately or together. Curiously enough the sex distribution also is almost identical in the three grades: 76 per cent of the grade I cancers, 80 per cent of the grade II, and 76 per cent of the grade III occurring in males.

Cancers of the cervix uteri occur at a younger age than tumors elsewhere (49 per cent in patients below 50 years of age, against 14.8 per cent for the group in Table II). However, the age distribution runs closely parallel for all three grades. This point is well brought out by Table III.

SEX DIFFERENCES

One interesting point brought out in the course of this study is the relative sex dis-

TABLE V.—RELATION OF MULTIPLE CANCERS TO GRADE

	Grade I		Grade II		Grade III		Ungraded	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Multiple cases	55	54	39	38	6	6	2	2
All cases	2130	47	1640	37	612	14	112	2

tribution of epidermoid carcinomata in various sites. In Table IV we note a marked preponderance of head and neck cancers (excluding lower lip) in the male (70 per cent as against 30 per cent). This is particularly marked in the case of the ear (88 per cent as against 12 per cent). The exposure of the male ear as contrasted with the female is undoubtedly an important factor. Not a few cases of carcinoma of the ear in the male give a history of antecedent frost-bite.

The skin of the upper face and the nose, where exposure is not unlike in the two sexes, shows a less preponderance of cancer in the male (58 per cent as against 42 per cent).

In the covered regions of the body, epidermoid cancer of the skin runs closely parallel in the two sexes (49 per cent in males and 51 per cent in females). In the extremities 70 per cent of the cases occurred in males.

Cancer of the lower lip is above all others essentially a male lesion, 2.9 per cent only occurring in females. The buccal cavity also presents a striking male preponderance (87 per cent). This preponderance is consistent in all parts of the buccal cavity.

When we consider the genitalia, however, the bulk of the cases occur in females, due to the great number of cases of cancer of the cervix uteri. Here 97 per cent, the proportion of female cases, is as striking as the marked predominance among males of the lip cases.

In spite of these wide variations in different parts of the body, the balance of the two sexes is very close in the entire group, 52 per cent being male and 48 per cent female.

The higher malignancy of the cancers of the cervix does cause a greater percentage of epidermoid cancers in the female to fall in the higher grades. Whereas of all our graded epidermoid cancers in males, 61 per cent fell in grade I and only 9 per cent in grade III, in females only 36 per cent were classified as grade I and 20 per cent as grade III.

In most sites, however, the sex ratio remains constant regardless of the grade. When marked variation appears, the number of cancers is small and the statistical significance but slight.

RELATION OF GRADE TO METASTASIS AND TO MULTIPLE CANCERS

One point that has interested us has been as to whether a given cancer maintained its grade in its metastases or became more or less malignant. This data has been obtained in only a relatively few cases because often only the primary growth was sent to the Tumor Diagnosis Service and because of the frequent failure of grade I cancers (of which the series contains many), to metastasize. From the data available we feel that usually the grade is maintained in the metastasis. If a change is noted, the metastasis is as frequently of a lower grade than the primary as of a higher. This impression parallels the experience of Mills, Broders, and Caylor.

The relative likelihood of metastasis in the different grades is beyond the scope of the present study, but has been presented in detail by us for certain groups of cancers (8), and further studies are in progress.

In our cases of multiple malignancy the grades of the epidermoid carcinomata do not vary significantly from the distribution by grades in our entire series. While we have pointed out (9) that cases of multiple cancer are more frequent than would be expected on the basis of chance, we see no reason to assume, as corollary to this, as Hurt and Broders do, that "the average grade of malignancy of multiple primary tumors should be higher than in a like group of single malignant tumors." In fact, one of the most frequently occurring cancers in multiple cases is

the basal cell carcinoma, which is certainly of as low malignancy as any type. As may be seen from Table V, grade I tumors predominate in our group of multiple cases.[1]

SUMMARY

1. The frequency of various grades of malignancy has been studied among 5,052 epidermoid carcinomata, removed from 4,987 patients.

2. Three grades of histological malignancy have been determined, chiefly on the basis of the degree of differentiation of the neoplastic cells.

3. Histological grading should not be used as a guide in individual prognosis, but is of service in determining group prognosis and of much help in estimating the probable radiosensitivity of a given cancer.

4. In general, epidermoid cancers developing in sites where the clinical malignancy is low tend to be of low histological malignancy, and where the clinical malignancy is high, the number of cancers in the higher histological grades of malignancy is increased.

5. Histological malignancy is independent of age and sex.

6. In certain sites epidermoid carcinoma is practically a sex limited disease.

7. Metastases tend to be of the same grade as the primary tumor from which they arose.

8. The histological malignancy is no greater in cancers from cases of multiple malignancy than in single cancers.

[1] By the nature of this study, multiple cases other than those having at least one epidermoid carcinoma are excluded.

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AN EARLY HUMAN EMBRYO *IN SITU*

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THE specimen which forms the subject of this report was discovered in the course of a postmortem examination which was made upon the body of a young woman who died in the New Haven Hospital on July 5, 1932.

Thirteen hours before her death she had taken two teaspoonfuls of an arsenic containing insecticide. Vomiting, diarrhœa, and abdominal pain commenced within a short time after ingestion of the poison. The patient was in a state of shock when she was admitted to the hospital. Despite the administration of arsenic antidotes and general supportive measures, she succumbed. No information pertaining to the menstrual history could be obtained. The necropsy was performed 5½ hours after death and in the intervening time the body was kept at 6 degrees centigrade. The primary anatomical changes included: acute hæmorrhagic and ulcerative gastritis and enteritis; epithelial and lymphoid proliferation and focal abscesses of the thyroid; diffuse myocarditis; subendocardial hæmorrhage (right ventricle).

The examination of the genital tract was made with great care as the initial inspection of the uterus revealed it to be boggy and enlarged and the possibility of an early pregnancy was recognized. In detail the gross findings in the genital tract were as follows: The mucosa of the vagina was pale pink, intact, and corrugated. The cervix was soft, symmetrical and somewhat enlarged. Projecting from the os was a white mucoid plug which completely filled the opening. The uterus was soft and symmetrically enlarged. The external overall measurements were 18 by 6.5 by 5 centimeters. On section the cavity was found to contain a small amount of mucoid material which clung tenaciously to the endometrium, particularly in the region of the fundus and right cornu. The endometrium was smooth, intact and bright pink. In the fundus and right horn numerous minute engorged blood vessels beneath the intact endometrium imparted a deep red appearance to the surface. Situated on the lateral wall halfway between the fundus and the internal orifice was a similarly reddened zone in the center of which was a tiny, pale yellow elevation 3 millimeters in diameter. The cross section of the uterine wall was not thickened and the cut surface presented a homogeneous, pale red appearance. The fallopian tubes were pale pink, soft and patent; their walls were not thickened and the fimbriated ends were free. The ovaries together weighed 9.4 grams. In the right ovary was a corpus luteum 2 centimeters in diameter.

MATERIAL

Blocks of tissue for microscopic study were removed from the right fundic region of the uterus, from the left lateral uterine wall including the pale yellow elevation and from the right ovary. The blocks were immediately fixed in Zenker-acetic solution for 24 hours. They were washed in tap water for an equal length of time and then dehydrated in graded alcohols and prepared for paraffin embedding. A section was cut from each block and stained with hæmatoxylin-eosin. In the case of the uterine tissues the plane of section was vertical to the endometrial surface. The section from the left lateral wall was found to contain an early ovum superficially embedded in the endometrium. The remainder of this block was accordingly cut in serial; each section was 10μ thick and all were mounted and stained with hæmatoxylin-eosin.

The series of 225 sections contains the entire blastocyst with the exception of a small portion of one end which was cut away when the block was trimmed. From a detailed study of the whole blastocyst it is estimated that not more than 50 sections are missing from this portion, i.e. 25 sections to the end of the cavity of the blastocyst and 25 sections containing chorionic villi.

GENERAL DESCRIPTION AND DIMENSIONS OF OVUM

Microscopic examination shows the ovum to be situated in a small prominence of the endometrium. Only in a small area toward the uterine cavity does the endometrial tissue fail to enclose the ovum. Here the defect is filled with an admixture of fibrin and blood cells undergoing early organization. The cavity of the blastocyst is lined with several layers of loosely arranged mesenchyme and filled with a mass of finely granular pink staining material. The embryo is attached to the mesenchyme on the inner wall of the chorion opposite the uterine cavity, and extends from section 48 to section 88 inclusive. It consists

of embryonic plate, amnion and yolk sac, and is surrounded by mesothelium.

Measurements of the several parts of the ovum were made from the projected images at known magnifications and from the number of serial sections in which the parts are contained. All measurements were taken at regions of maximum diameter. The external measurements of the blastocyst are 2.75 by 1.92 by 0.92 millimeters. The internal dimensions of the blastocyst are 2.17 by 1.40 by 0.61 millimeters. (Allowance was made in computing the long diameters of the blastocyst for the amount believed to have been lost in trimming of the block). The external measurements of the embryonic mass are 0.41 by 0.24 by 0.17 millimeters. The ectodermal disc measures 0.24 by 0.3 millimeters. Its thickness was not computed.

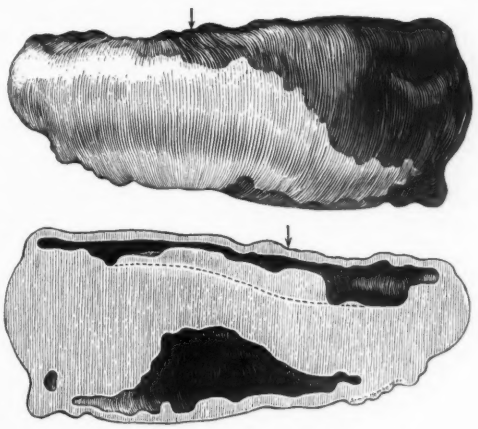

Fig. 1. Upper, Lateral view of embryo drawn from wax reconstruction, ×165. The darker zone represents the attachment to the primary mesenchyme; the light zone, the surface exposed to the chorionic cavity.

Lower, Median sagittal section drawn from model, ×165. The dorsal cavity is the amnion and the ventral the yolk sac. The arrows indicate the location of section 61, photomicrographs of which are presented in Figures 2 and 3.

ENDOMETRIUM

The surface epithelium of the endometrium in general is intact. The endometrial glands are greatly enlarged and have the typical corkscrew appearance of the premenstrual mucosa. The cells lining the glands are tall columnar with pink, granular cytoplasm and pale blue vesicular nuclei. No mitotic figures are seen. The cells are swollen and project irregularly into the lumen of the glands. In many places the epithelial cells have desquamated and lie free within the lumina together with a finely granular pink staining material. Throughout the endometrium the stroma is œdematous, the capillaries are distended with blood, and there is a sparse scattering of polymorphonuclear leucocytes.

The implantation site is sharply demarcated from the rest of the endometrium by a zone of widely dilated capillaries which form a cushion upon which the blastocyst rests. In this border zone there appears to be more œdema and cellular infiltration than elsewhere in the endometrium. In several places, particularly near the surface, there is also extravasation of red blood cells.

TROPHOBLAST

The wall of the blastocyst is irregular in outline with numerous small outpouchings into which the mesothelium extends. An average of 8 to 10 such projections are seen in each section. These apparently represent primitive chorionic villi and in approximately one-half of the instances a dichotomous division has occurred.

Immediately outside the mesothelial lining of the chorionic cavity is a single layer of small cuboidal cells arranged in palisade. Occasionally the cells are heaped up into 2 or 3 irregular layers, particularly in the outpouchings. The cytoplasm of the cells is deep pink and granular and the individual cell outlines are distinct. The nuclei, which are vesicular and contain dark blue granular chromatin, occupy the greater part of each cell.

Closely adherent to the outside of the cuboidal cell (Langhans) layer is a thin lavender staining protoplasmic covering (syncytium). Cell outlines here are absent and dark blue irregularly elongated nuclei are distributed at intervals. Protoplasmic prolongations of this layer extend outward and form the lining of large spaces which are filled with blood. In many instances these lacunæ are immediately adjacent to the wall of the blastocyst; elsewhere they are further back from the cavity, but in all cases the syncytium lines the space. Other syncytial processes ex-

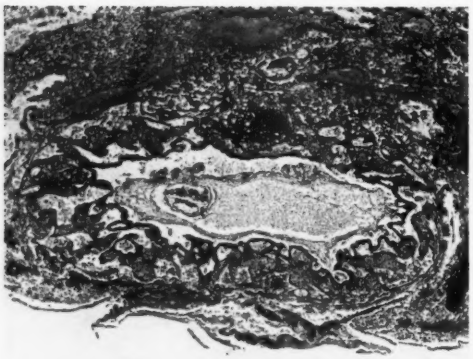

Fig. 2. A photomicrograph of the implantation site which shows the relation of the ovum to the surrounding endometrium and uterine cavity. The embryonic mass, the chorion, the trophoblastic layers and the dilated blood vessels of the border zone show clearly. ×30.

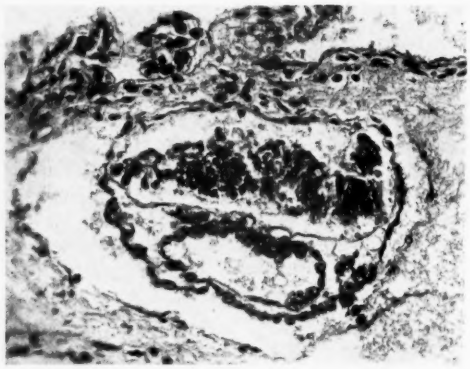

Fig. 3. A photomicrograph of the embryonic mass seen in Figure 2. Amnion, chorion, and ectodermal plate are seen lying at one pole of the blastocyst attached to the chorionic mesenchyme and surrounded by an endothelium-like mesothelial membrane. ×215.

tend into the surrounding endometrial stroma and appear to invade the walls of the dilated blood vessels. In many places direct communication between the lacunæ and the capillaries has been established.

Between the lacunæ, extending radially from the cuboidal cell layer, are masses of large, foamy, polyhedral cells with large, pale blue, vesicular nuclei. The cell boundaries stain pink and stand out prominently. Mitotic figures are abundant. These columns extend outward and gradually merge into the surrounding endometrial stroma within the zone of the dilated capillaries.

EMBRYO

In Figure 2 is seen a low power photomicrograph of the entire ovum (Section 61). The embryo proper is attached to the mesenchyme on the inner wall and at one pole of the chorionic cavity. Its general form is indicated by the drawings of a wax reconstruction of the entire embryo presented in Figure 1. In the external view, the shaded portions show the places of attachment to the primary mesenchyme while the light areas represent the surfaces which are exposed to the cavity of the chorion. It is of interest to note that the left end stops bluntly and is entirely free of mesothelial attachment while the right is completely encased in mesenchyme. The dorsal surface forms the greatest area of attachment. The ventral surface is almost entirely free with the exception of a small band of attachment extending about halfway along this surface from the encapsulated end. The median sagittal section shows two cavities, the dorsal represents the amnion and is the larger of the two. The floor of the amnion has an extremely irregular outline which is the result of the marked shrinkage and displacement of the cells of the ectodermal plate. The broken line represents the level at which the floor of the amnion presumably would be situated were the cells undisturbed in their alinement. The ventral cavity is the yolk sac which is completely separated from the amnion by the intervening ectodermal plate. At the left end is a duct-like projection of the cavity which extends into the enveloping mesenchyme.

Figure 3 is a high power photomicrograph of Section 61. It shows the embryo and the immediately surrounding portions of the blastocyst. The yolk sac is lined by entodermal cells which are cuboidal on the dorsal surface and flattened on the ventral surface. The sac is partially filled by pink staining, finely granular material. In other sections large yolk granules are present within the cavity. The entodermal lining of the yolk sac abuts on the basement membrane of the ectodermal plate with no vestiges of an intervening mesothelial layer. The embryonic shield forms th

floor of the amnion and is made up of a single layer of tall columnar cells arranged in palisade, resting on a distinct basement membrane. The cells have large, oval, vesicular nuclei and abundant cytoplasm. In the middle of the ectodermal plate their outlines are indistinct and the regularity of their arrangement is destroyed. The lateral walls and roof of the amnion are lined with flattened, elongated cells. The roof is bound intimately to the overlying mesenchyme.

Around the embryonic mass is a space which in many places is continuous with the chorionic cavity although for the most part it appears to be closed off from the main chamber. This space is limited by a single layer of flattened mesodermal cells having the appearance of endothelium. This layer not only surrounds the space but likewise completely encloses those surfaces of the embryonic mass not directly attached to the mesenchyme. On the surface toward the main cavity the continuity of this membrane-like structure is less well maintained; and irregularly distributed openings in it offer probable avenues of communication between the larger and smaller spaces. In addition, from this surface long strands of mesenchymal cells stretch out traversing the main cavity. A finely granular, pink staining material, similar to that in the main cavity of the blastocyst, is present within the smaller space.

SUMMARY

The state of preservation of the structures of the specimen is excellent. Only in certain details are there evidences of early disintegration, in summary:

The epithelial cells of occasional endometrial glands have sloughed into the lumina.

The individual chromosomes of the karyokinetic figures are indistinctly differentiated.

The cells of the ectodermal plate have become dislodged from their basement membrane. It is only in this structure that serious distortion of the configuration has occurred.

Since these changes involve only the more fragile structures it seems justifiable to assume that they are of postmortem origin and that the embryo was developing normally until the death of the patient.

In the absence of all menstrual history the age of the embryo must be estimated from a comparison of its developmental stage with that of other young human ova of better known age. The lack of a primitive streak places it in Group I of Streeter's classification. The primitive nature of the chorionic villi, the size of the blastocyst, the relative sizes of the amnion and yolk sac and the dimensions of the embryonic parts indicate that it is of approximately the same age as the Peters embryo, i.e., 12 to 14 days.

The authors wish to thank Professor Leon S. Stone of the Department of Anatomy, Yale University for his guidance and direction in the study of the material presented in this paper. They also acknowledge to Dr. George L. Streeter of the Carnegie Institute their appreciation of the valuable suggestions offered regarding the interpretation of the microscopic preparations.

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CONGENITAL TORTICOLLIS

A Review and Result Study

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CONGENITAL torticollis, collum distortum, caput obstipum, or wry neck, is a well recognized deformity of the head and neck characterized by the approximation of the mastoid process of the temporal bone to the sterno-clavicular articulation on one side or the other. In rare cases the condition may be bilateral with resultant forward inclination of the cervical spine and head.

HISTORICAL

The condition was recognized in antiquity and Alexander the Great is said to have suffered from the deformity (Colonna). According to von Lackum the first known attempt at correction by open section of the muscle was made by Isaic Minnius in Germany in 1641. In this country the first reported cases were by John Warren of Boston, in 1841, and John Brown of the same city in the following year.

Buckminster Brown discussed the treatment and presented cases before the annual meeting of the Massachusetts Medical Society on June 3, 1868. He stated that apparatus, particularly the brace devised by Dr. John R. Brown, completely relieved many patients, while others are generally incurable without division of the offending muscles.

INCIDENCE

Tubby observed the incidence as about 0.3 per cent of children in a surgical hospital (8 cases of 2,324 admissions at Evelina Hospital for Children), 0.3 per cent of orthopedic cases (15 of 5,079 cases at the Royal National Orthopedic Hospital), and less than 0.2 per cent of other observed patients (9 of 5,190).

Colonna, reporting from the Hospital for the Ruptured and Crippled, New York, gives the incidence as 0.5 per cent (269 of 55,000 orthopedic cases), while Howell states that it occurs once in every 150,000 births, and is one-tenth as common as congenital club-foot.

In the Shriners' Hospital for Crippled Children, at Springfield, Massachusetts, there have been 39 cases in 1,898 admissions from the opening of the hospital in February 1925 to September 30, 1933, an incidence of 2.1 per cent. The distribution by years has progressively increased from 0.4 per cent in 1925 to 3.5 per cent in 1932 and 1933.

TYPE OF DEFORMITY

There are three general divisions of torticollis, congenital, acquired, and spasmodic. The cases which we are considering in this series are exclusively of the congenital type, and we will limit our discussion to this group. In our experience this type has been much more common than the acquired or spasmodic. This is partially borne out by inference from Steindler's report of 27 myotomies of the sternomastoid of which 21, or 80 per cent, were for congenital torticollis. Whitman, however, reports that of 507 cases only 87, or 17 per cent, were congenital; while Redard found 18 congenital cases in a series of 70, or 25 per cent. During the past 5 years there has been much more in the literature concerning the acquired than the congenital type.

SEX DISTRIBUTION

Albee and Howell state that the condition is more common in girls than in boys, and Kempf reports 24 girls and 13 boys in his cases. Whitman's series of 87 is almost equally divided, with 46 girls and 41 boys. Colonna found 147 boys and 122 girls. Aberle reported 23 boys and 14 girls. In this series there were 27 boys and 30 girls. Combining the above series we find a total of 251 boys and 230 girls. It appears safe to state that there is no sexual predisposition.

RACIAL TENDENCY

Racial predisposition is not mentioned in the literature, and the condition has been

subject of interest to writers in French, German, Scandinavian, Italian, Spanish, and English, implying widespread occurrence. In our series taken from the mixed racial population of New England, there were 25 Anglo-American, 14 French-Canadian, 8 Italian, 3 German, 3 Irish, and 1 each of Swedish, Greek, Armenian and Polish ancestry.

SIDE INVOLVED

As has been previously mentioned, there have been bilateral cases occasionally reported, but these are rare. In the case reported by Gupta, there is insufficient data to classify the condition accurately, but it is obviously not a congenital torticollis. There are no bilateral cases in this series.

Osler states that the right side is affected almost exclusively. Colonna found 27 cases of right involvement and 24 of left in 51 cases, while Hutter cites 26 of the right side and 17 of the left in 43 cases, and quotes Grimm's series of 38 cases with 21 right and 17 left, as well as Binder's collected statistics showing 344 right and 266 left. Hutter attempts to explain a right sided predilection by the increased venous pressure on the right, due to the valveless veins of the right lobe of the thyroid presenting a straighter continuation of the superior vena cava than do those of the left. He quotes Breitner and Starlinger's observation that diffuse forms of struma are preponderantly right sided. Hutter also states that cerebral abscesses are more frequently right sided than left, and that a survey of hæmangiomata of the face showed 14 on the right side to 7 on left. Whitman, on the contrary, reports 20 cases with right sided involvement and 38 left sided in a series of 58 cases. In our series, 31 cases (54 per cent) were right and 26 cases (46 per cent) were left. Combining the above figures we find 469 right sided opposed to 388 left, or 55 per cent right and 45 per cent left. There seems to be a slight predilection for the right.

ETIOLOGY

In spite of many theoretical speculations and some careful investigations, there is still a wide variation in suggested causes of this condition. We exclude at once those cases caused by congenital bony abnormalities, such as hemivertebra, cervical rib, fusion of the atlas and occiput, or of the axis and atlas. These conditions may simulate true torticollis, but in our opinion should be classified as congenital malformation of the cervical spine, and the term torticollis reserved for the deformity of muscular origin. No cases of this type have been included in this series. Albee, Whitman, and Nové-Josserand and Vianny, all describe this group under torticollis, and Schulze considers this the most frequent cause. All cases in this series have been examined with the X-ray and in only one case has a bone lesion or defect been present. This was a mild spina bifida which was felt to be of no significance. Jones and Lovett use the term "primary" for this group of cases, but we much prefer Elowson's nomenclature of "osseous" as opposed to "myogenic" torticollis.

The most widely supported theory of causation is abnormal intra-uterine position or increased intra-uterine pressure. This is, of course, entirely speculative, but has been a popular explanation, not only of this particular deformity, but also of others.

Jones and Lovett use as supporting evidence the co-existence of congenital club-foot due to the same cause. Here again the pressure is subject to question, and even if admitted the association does not necessarily follow. No such association of club-foot or other deformity has been observed in this series. Beck denies that uterine pressure can be a cause, and cites Sippel's X-ray studies as showing intra-uterine muscular torticollis without narrowing of the uterus. Campbell lends the support of his statement to abnormal position *in utero* as a cause, as also Whitman, Colonna, and Hohmann. Argument against this may be drawn from Joachimstal and Volcher, who report a case occurring in extra-uterine gestation.

Among other theories of etiology are (1) heredity, (2) constitutional defect, (3) arrested development, (4) birth injury, (5) infective myositis, and (6) ischæmic fibrosis.

Aberle and Schubert emphasize the hereditary influence and cite cases to bear out this contention, and von Lackum reports three of four children in one family with torticollis.

The number of such reported cases, however, is few, and it would appear to be the exception to find a familial history rather than the rule. In no case in this series is there any evidence of an hereditary factor.

Schubert also cites as evidence of a constitutional cause the fact that after operative extirpation there is scarry regeneration. This would hardly seem to be a valid argument. He quotes Krogius and K. H. Bauer as authorities that the degenerative changes are indubitably due to faulty embryonic anlage, but that they may be stimulated by trauma. He is not satisfied with this explanation, but feels that there is a trophic inhibition of the central nervous elements ruling this faulty anlage. As additional evidence to support this theory he cites the association of other anomalies.

Bradford and Lovett quote Osler, Golding-Bird, and Shaffer that the cause is an arrest of development of the sternomastoid muscle due to affection of the nerves or nerve centers. Campbell uses the inclusive term of "error in development."

The relation of obstetrical injury to the deformity has been stressed. Stromeyer almost a hundred years ago advocated the theory that the underlying cause is rupture of the muscle at birth with formation of an hæmatoma. Confusion has resulted from the unwarranted consideration of the early enlargement of the muscle, the so called "sternomastoid tumor," to be due to hæmorrhage in the muscle. All of the older literature refers to this tumor as an hæmatoma, and its existence was taken by some as evidence of the traumatic causation of the deformity. Jones and Lovett state: "There are some hæmatomata without wry neck and some wry necks without hæmatoma but it must be regarded as one of the causes." They emphasize that the rupture may take place in a previously shortened muscle. Campbell considers that the condition resulting from hæmatomata should be considered as acquired rather than congenital, which argument has a certain amount of logic. Whitman summarizes the argument against hæmatomata as a cause in four points: (1) rupture of other muscles does not cause myositis and contraction; (2) Heller has shown that experimentally a pyogenic infection is necessary to cause such a myositis and contraction; (3) in a series of 55 cases of congenital torticollis only 7 gave history of birth injury; (4) in 7 cases of hæmatomata of the sternomastoid during delivery, none developed torticollis. Aberle quotes Peterson, Kredl, Friedberg, Spitzy, and others who have reported hæmatomata not followed by torticollis. Keetley, however, followed 30 patients with hæmatomata and found 11 eventually developed a wry neck.

A recent very excellent study by D. Stewart Middleton from the Hospital for Sick Children, Edinburgh, points out that the "sternomastoid tumor" lacks many of the characteristics of a "hæmatoma." There is never any ecchymosis, or fluctuation, but from the onset the mass is firm, hard, and cartilaginous to the touch. The process is diffuse instead of localized, and further there is an interval of 1 or 2 weeks after delivery before the tumor appears, which is not consistent with hæmorrhage. Finally Middleton states that excision of the tumor definitely proves that it is not due to hæmorrhage. On section the tumor shows a glistening, fibrous tissue not unlike a soft fibroma. Histologically this is a young cellular fibrous tissue containing scattered degenerated muscle fibers. This same pathology was reported by von Lackum in a series of 4 cases in which he excised the mass.

Albee states that the condition is frequently, although not always, associated with difficult delivery occasioned by dystocia from malpositions and malpresentations. He also observed association with obstetrical paralysis. In 2 cases in this series this combination of torticollis and obstetrical paralysis has occurred. Middleton observed 54 cases of Erb's paralysis seen from birth to 3 months and found 11 cases of "sternomastoid tumor."

Colonna contributes some statistics in regard to obstetrical history, finding dystocia in 13 of 22 cases, or 60 per cent. He reports one breech presentation in 51 cases, which is less than the normal occurrence of 3 per cent Rosenbaum reported 6 abnormal deliveries in 9 cases of torticollis including 3 forceps, a breech, and a frontal presentation. Against the argument of birth injury is the case re

ported by Rossi delivered by cæsarean section without trauma in which the deformity was marked. Middleton reports the obstetrical history of 64 cases. Of these, 43 were born of primiparæ, and of the 21 babies remaining, 16 were "difficult prolonged labors," "cross-births," or "breech presentations." Of 83 cases 14 had a normal labor, 46 were difficult or prolonged, 15 were breech presentations, and 8 were cross-births. Aberle, in a series of 37 cases, found 22, or 60 per cent, with abnormal labor including 16 breech presentations, 1 face, and 5 forceps. In 5 cases there was no obstetrical history, and only 10 were said to be normal birth.

In this series, data as to the obstetrical condition was obtained in 35 cases. Fifteen had normal delivery, one of which was also stated to be easy. In 4, delivery was said to be difficult, in 1 of which the mother died. Six were instrumental deliveries, 3 of which were characterized as difficult. Ten were breech deliveries with 8 specifically stated as difficult, instruments being required in 2 and labor unduly prolonged in 3. One child was 10 weeks premature weighing 5¾ pounds.

Combining the available statistics on obstetrics we find of 202 cases, 146, or 72 per cent, are reported to have had difficult abnormal labor, and of 210 cases there were 43 breech deliveries, or 20 per cent. No other single finding was reported in enough series to be of significance.

Some authors have attempted to attribute torticollis to an infective agent. As previously stated, Whitman, in his arguments against trauma and hæmorrhage, quotes Heller's experimental work that a pyogenic infection is necessary to cause a myositis. Mikulicz and Kader accepted this theoretical infection as the primary cause; but, as Albee pointed out, no organism has ever been shown to be present. Furthermore, the pathological picture, as well as the clinical course, fails to support this theory. Albee also mentions, but does not support, the theory that the primary disturbance is a localized luetic sclerosis of the muscle. In our cases blood Wassermann reactions have not been taken, but none of the children have shown any suggestive stigmata of congenital syphilis.

The final theory which has been offered to explain the origin of this deformity is that it is produced by an ischæmia due to prolonged partial obstruction of the blood supply, and represents a condition analogous to Volkmann's ischæmic paralysis. Volcher, in 1902, and Nové-Josserand and Vianny, in 1906, originally advocated this theory and it is supported by Albee. They point out the anatomical fact that certain positions through which the head may pass in delivery can readily obstruct the blood supply of the sternomastoid. Middleton assumes that the vascular interference is not arterial but is venous, and quotes Jepson's observation that a venous blockage which has been complete for a few hours is capable of initiating a process of fibrosis which continues even after the obstruction has been relieved. Brooks has also experimentally produced an analogous condition in the sartorius of a dog by venous ligation. Middleton repeated this work, and demonstrated the same type of microscopic pathology as was found in the sternocleidomastoid in his cases of torticollis. In our opinion, this theory is the most logical and best supported explanation.

PATHOLOGY

The pathology has been described as a sclerotic interstitial myositis with Zenker's waxy degeneration producing dense induration and shortening. This condition is usually limited to the sternomastoid muscle, but in long standing severe cases the platysma, scaleni, and splenius may be shortened (Albee). In 2 of our 35 operative cases, shortening sufficient to prevent correction was found outside of the sternomastoid. In 1 case this was in the scalenus anticus, and in the other in the splenius capitis. In 2 of the non-operative cases, the trapezius was definitely involved.

It has been our observation that frequently one part of the muscle will stand out much more definitely than the rest; and Howell states that the sternal head is more commonly involved. In our 57 cases no mention was made in 32, and in 2 it was noted that both the sternal and clavicular heads were contracted. Of the remaining 23, 16 showed primarily sternal head involvement and 7

clavicular. In all cases, however, it was found that both components were to some extent deforming factors.

The pathology of the early stage as described by von Lackum and Middleton, has already been stated. The sternomastoid sheath is shown to contain a firm, white, glistening mass composed of a young cellular fibrous tissue containing scattered degenerated muscle fibers. The late picture seen in the developed case of torticollis as described by Middleton, represents an end stage of this sternomastoid tumor. Sections of this excised muscle show thick bundles of adult non-cellular fibrous tissue containing small muscle fibers scattered through it.

CLINICAL COURSE

The various texts state that the condition is noted at birth or soon after. Colonna reports that 14 cases of a series of 51 were noted at birth, while in 42 cases the average age was 11 to 12 months. He explains this "extremely high average" as due to the fact that several were reported as first noted at about 5 years, which "seems inconceivable." Eliminating these cases the average is reduced to 3 months. Hellstadius, on the contrary, emphasized the fact that frequently cases do not develop for many years after birth. Middleton also states that the clinical onset of deformity is often late, usually at about 4 years in his experience. He explains this fact by pointing out that there is not an actual shortening at the muscle, but an impairment of growth which prevents the muscle from keeping pace with the development of the rest of the cervical region. Thus the deformity becomes clinically evident during the period of rapid growth.

Our experience agrees with that of Middleton and Hellstadius. Approximately 30 per cent of our cases were first detected soon after birth, about 20 per cent more during the first year, and in approximately 15 per cent the deformity was not observed until the child was nearly of school age, and in 1 case not until the child was 7 years old. In 11 cases no history as to the first appearance of symptoms was obtained. In 14 cases the onset was given as "birth" in 5 cases; "soon after birth" in 2; 3 days; 1 week; 3 weeks; 4 weeks; and in 3 cases, 1 month. Many of these cases presented on examination or gave a history of definite "sternomastoid tumor." In 11 more cases the deformity was noted during the first year. These were noted as "infancy," "early infancy," "under 6 months," 2, 3, 5, and 7 months each in one instance, while 2 were observed at 4 and 6 months. In 5 cases the onset was in the second year, in 4 in the third, in 5 in the fourth, and in 4 in the fifth. Two children were 5 years of age and 1 was 7. It is of interest that in one of the older children, although the parents insist that no deformity was present before 4 years of age, photographs taken in infancy show a definite inclination of the head to the affected side.

FACIAL ASYMMETRY

Of considerable importance and interest is the typical distortion and asymmetry of the face, with general atrophy of the side of deformity. Aberle, Hoffa, and others have very aptly used the term "facial scoliosis" to describe this condition which is a constant finding when the deformity is more than of very short duration. The deformity is not limited to torticollis but may be caused by luxations, syphilitic or tuberculous disease of the spine, or scar contraction following trauma. Jones and Lovett state that this is due to circulatory abnormality but Walter has given a much more logical explanation based on the alteration of pressure and traction forces brought about by the permanent oblique posture. He also reports a very interesting case in which a left convex facial scoliosis in a case of right torticollis was converted into a right convex facial scoliosis by 17 weeks' overcorrection. Hagen-Torn explains the progressive deformity as well as the facial asymmetry as solely due to the difference in growing power of the bone on the two sides. This power, he assumes, is the resultant of the tissue tension produced by the growing bone and the inhibition produced by the shortened muscle. He has devised a very interesting model consisting of the skull and cervical vertebra mounted on a double spring. The sternomastoid muscles are represented by elastic bands and the deformity is produced by shortening one band. On release of the upper spring, the deformity is

greatly exaggerated. He states that after operative release the potential energy of the growing part is converted into a kinetic energy, so that the affected side catches up with the normal side and thereafter proceeds in harmony with it. It is our impression that the asymmetry is roughly proportional to the age as stated by Walter and the severity of the deformity, although Aberle states that there is no parallelism between the degree of muscle change or deformity and the degree of asymmetry.

An attempt was made to estimate roughly the amount of facial asymmetry in this series. In 5 cases there was very little distortion, 3 being classified as mild, and 2 cases as slight. Of these 5 cases two were infants. In 22 cases the asymmetry was classed as moderate and in 17 as marked. The degree of deformity was also roughly estimated as extreme in 2 cases, marked in 15, moderate in 23, and mild in 2.

AGE AT OPERATION

It is of particular interest since all authorities agree in the desirability of early treatment that no case in this series had received the benefit of any treatment, previous to admission. Aberle, in an operative series of 37 cases from Germany, reported approximately half the cases under 1 year (20 cases), one-quarter between 1 and 6 (8) and one-quarter between 6 and 14.

In this series of 39 cases, only 4 were infants. These cases were 6, 9, 10, and 18 months. The remaining 90 per cent varied from 5 to 14 years and averaged a little over 9 years. The ages were 5 (2 cases), 6 (2 cases), 7 (7 cases), 8 (5 cases), 9 (4 cases), 10 (2 cases), 11 (2 cases), 12 (6 cases), 13 (3 cases), and 14 (2 cases).

NON-OPERATIVE TREATMENT

In considering the non-operative treatment in this series, it is important to remember that most of our cases were fairly well along in childhood and had no previous treatment. Campbell states that non-operative treatment results in correction in a large proportion of cases under one year. Colonna finds methodical stretching usually all that is required under 6 months, while in a total series of 269 cases 140 (52 per cent) were satisfactorily treated by this means. Howell feels that all early cases can be cured by manipulation within 3 months. Von Lackum, on the contrary, advises early operation as does von Landgraf.

In 8 cases, operation was not advised and treatment by manipulation and stretching was carried out at home, and in the Out-Patient Physiotherapy Department. In one case a Thomas collar was also used. These cases were all in young children, treatment being started at 5 weeks, 3 months, 6 months, 7 months, 15 months, 2 years, and 3 years in 2 cases. In the three oldest cases the deformity was slight and in 1 had been previously treated elsewhere by stretching. In all of these cases the results are satisfactory to date. Complete active and passive overcorrection was obtained in from 3 months to 1 year, and this with a disappearance or decrease of the cranial and facial asymmetry has been maintained in 6 cases from 1 to 6 years. The follow up period has been 1 year in 1, 2 years in 2 cases, and 4, 5 and 6 years in 1 each. Opposed to these 8 cases there have been in this series 3 operative cases 1 year old or younger. Possibly non-operative treatment might have been satisfactory in these cases, but it was not elected because of the severity of the deformity and the home situation.

Rosenbaum has advocated a chemical treatment designed to soften the cicatricial tissue. This consists of the injection of a 1 per cent solution of pepsinum purissimum in Pregl's iodine solution according to the method of Payr. At first 0.5 cubic centimeter and then 1 cubic centimeter was injected twice weekly directly into the tumor. Altogether 1.5 to 6 cubic centimeters were used. He reported immediate results in all of 9 cases, 3 of whom showed complete functional cures when examined at the end of one year. We have had no personal experience with this method of treatment.

OPERATIVE TREATMENT

Lorenz advocated subcutaneous rupture, or myorrhexis. This is condemned by Steindler as dangerous and obsolete. The procedure has

not been attempted in this series, because of our theoretical agreement with Dr. Steindler. Subcutaneous tenotomy has also been advocated, but we have not used it because we have felt that it would be insufficient to permit correction. Howell reports 23 operations on late cases in which subcutaneous tenotomy was done on the sternal head and two by open division. One case of twenty-one done subcutaneously failed to give a complete cure and a secondary open division of the origin of the muscle was done with good result.

Open division of the origin of the muscle is the usual method of correction. Lange originally advocated division of the insertion below the mastoid as quoted by Bradford and Sever which has been recently advocated by Hellstadius with subcutaneous sternal tenotomy in milder cases, particularly because of the hidden scar above the hair line. Mikulicz advised resection of the muscle. Jones and Lovett also describe a method of plastic lengthening of the middle portion of the muscle, similar to the technique more recently advocated by Hagen-Torn. The tenoplastic method of Foederl consists of division of the origin with suture of the clavicular to the sternal head. Albee states that kneading of the muscle must be performed after division, at the same time traction is made on the arm and head.

The after-treatment is emphasized as of utmost importance by most authors and consists of a period of fixation followed by massage and exercises. Albee and Whitman recommend fixation for 4 to 8 weeks; Steindler, from 2 to 3 months; and Jones and Lovett, from the day after operation for at least 6 weeks. Hagen-Torn, however, feels that these procedures are definitely harmful after 1 week. He urges faradization and massage on removal of stitches followed by active exercises.

The operative procedures in the cases of this series have consisted of division of both the sternal and clavicular origins of the muscle, and when necessary a subcutaneous tenotomy of the insertion was also done. A partial division of the scalenus anticus was necessary in 1 case, and of the splenius capitis in another. In 10 cases approximately 2 centimeters of the sternal head was resected in order to obtain adequate overcorrection, and in 2 cases about 1 centimeter of the clavicular portion was excised. These cases were among the earlier ones of the series, and this resection has since been abandoned for two reasons: First, it is usually not necessary for complete and permanent correction; and, second, the absence of the normal prominence of the sternal head leaves a permanent asymmetry of the neck which is cosmetically undesirable. In 3 of these 12 cases with resection, the insertion was tenotomized.

In order to avoid the disfiguring loss of the sternal head, attempts were made to preserve it in so far as was found compatible with correction. In 1 case, nothing was done to the sternal head, the clavicular head or origin being divided and the insertion tenotomized. In 7 cases the sternal head was lengthened by partial transverse incisions at two levels and the clavicular head divided. In 4 of these the insertion was also tenotomized.

In 19, or about half the cases, both the sternal and the clavicular heads were completely divided, and in 6 of these a subcutaneous tenotomy of the insertion was combined. In the entire operative series, the insertion was divided in 14 cases, 36 per cent of the series.

In all the cases, particular attention was given to obtaining the least possible scar. A minimal skin incision of about 2 or 3 centimeters was made obliquely below and to the outer side of the sternal end of the clavicle in the line of the skin fold. The loose tissue permits adequate exposure of the entire origin of the muscle through this incision. The superficial fascia is closed with interrupted sutures of No. 00 plain catgut, and the skin sutured with a subcuticular stitch. In spite of the fact that the wound is placed under tension in correcting the deformity, only three scars have been at all objectionable. One case shows a definite keloid, one a slight keloid, and one some broadening of the scar. In the remaining 92 per cent the scars are small, freely movable and not disfiguring.

The postoperative fixation was by plaster helmet in 19 cases, plaster collar in 9, Thomas collar in 2, brace in 2, and sponge rubber crutch top as pad in 2. Head traction was ap-

plied in 5 cases. This was used for about 1 week in 4 patients and continued for a month in the other case. This was followed by plaster helmet in 4 cases and by a brace in the other. The time of application of fixation varied from 2 to 9 days after operation. The duration of fixation varied from 3 weeks to 5 months, and 1 exceptional case in which there was a marked high scoliosis had 14 months fixation. The usual period of fixation was about 6 weeks.

Following the removal of fixation, all children have been given physiotherapy consisting of active and passive stretching, sometimes with suspension, corrective exercises, massage, and sometimes baking. When possible these treatments were carried on in the clinic about twice a week for from 1 to 3 months, followed by once a week or once every 2 weeks for another 3 to 6 months. In those instances in which the child could not be brought to the physiotherapy department, the mother and child were carefully instructed in carrying on the treatment at home. Although no supporting evidence can be adduced from these cases, it is our opinion that this part of the after-treatment is of great importance.

RESULTS OF TREATMENT

Osler, in discussing this condition, states that it is unimportant as it is readily relieved by tenotomy, but he quotes Golding-Bird that the facial asymmetry persists "or, indeed, becomes more evident." Albee states the facial asymmetry persists from 2 to 3 years after correction but gradually disappears. Aberle states that the facial asymmetry usually disappears after operation, but good results are to be expected only prior to 5 years of age, since at this age the growth of the skull practically ceases. Beck, on the other hand, claims that facial asymmetry does not disappear after surgical treatment. Meyerding reported 26 cases of open tenotomy with 14 cured and 4 improved; i.e., 8 cases (30 per cent) unimproved. Steindler reports 27 operations, 6 of which were for other conditions than congenital torticollis according to his classification. With the standard as good active and passive overcorrection, his immediate results were good in 88 per cent, poor in 12 per cent, and the remote results were good in 77 per cent and poor in 23 per cent. He attributes his failure to "error in technique in 2 cases, and inability to correct due to severe respiratory embarrassment in another." He does not state whether these failures were in the congenital group.

In our cases 35 have been followed from 1 to 7 years after operation, while 4 were under 1 year when last seen. In the recent cases the time interval is too short to estimate the result. Of the 35 cases followed more than 1 year, 12 are under 2 years, 8 between 2 and 3 years, 9 between 3 and 4 years, 2 between 4 and 5 years, and 4 more than 5 years. All show good active and passive overcorrection of the deformity. One case has some residual cervicodorsal scoliosis which is perhaps paralytic in origin. Sixteen cases show a prominent residual band on complete overcorrection. In 2 cases in both of which muscle was resected, secondary operation was seriously considered at one time, namely 1 to 4 months after operation in the first and 3 to 5 months in the second. In neither case has there been any recurrence of deformity. The band stretched out and no additional surgery became necessary.

In 3 cases this residual or recurrent band in the clavicular portion of the muscle was sufficient to require tenotomy. This was done 1 year after the original operation in 1 instance and after 3 years in 2 cases. Including these cases the band was in the clavicular portion of the muscle in 13 cases, and usually well toward the lateral border of the muscle. In 2 cases the band was in the upper part of the muscle, and in 1 instance it was in the sternal head.

We have already referred to the unsightly prominence of the inner end of the clavicle and the asymmetry of the neck produced by loss of the sternal head. This is present in 12 cases or one-third of our series. We feel that this should be emphasized because it can be avoided in most cases without jeopardizing the results. The loss involves no functional disability, but particularly in the female it is cosmetically undesirable.

In most cases we have observed a very rapid improvement in the facial asymmetry during the first 6 months, following the initial ap-

parent increase. This immediate change is, of course, not real, but, because of the assumption of correct head posture, the pre-existing change is made more obvious. After the first 6 months, the spontaneous correction apparently becomes slower, and although 2 cases showed a complete return to normal in 1½ years, a little difference can usually be detected up to 4 years. As would be expected the improvement in facial asymmetry appears to be more rapid in the younger children, but this could not be quantitatively expressed. In all cases the greater part of the asymmetry was corrected in 2 to 3 years, and most of the children followed more than 3 years present no greater asymmetry than is often seen in normal children.

SUMMARY

1. This study is based on a series of 57 cases of congenital torticollis which represents an incidence of 2 per cent of the admissions of an orthopedic hospital during the past 8 years. This incidence is much higher than previously reported in the literature, and has been progressively increasing at this institution.

2. There is no sexual nor racial predisposition.

3. The right sternomastoid muscle is slightly more commonly involved than the left.

4. The deformity is frequently though not necessarily associated with a history of some sort of obstetrical difficulty.

5. While no proof or additional evidence on the problem of pathogenesis is adduced, the explanation of ischæmic fibrosis based on venous obstruction seems most acceptable.

6. Contrary to previous writers, it is our opinion that in many of the cases the deformity does not become apparent until late infancy and early childhood.

7. The results obtained by repeated manipulative stretching in infancy are frequently satisfactory.

8. In older cases, some method of surgical division of the sternomastoid muscle is necessary.

9. Complete excision of the sternal head of the sternomastoid causes an asymmetry of the neck with loss of normal contour and a marked prominence of the sternal extremity of the clavicle. This cosmetic defect can be obviated by plastic lengthening of the tendon.

10. Postoperative treatment is of importance.

11. Full active and passive overcorrection of the deformity was obtained in all cases in this series.

12. Facial asymmetry is more obvious immediately after correction, but then improves rapidly for about 6 months. Subsequently, there is slower improvement, usually becoming complete or nearly complete in about 3 years.

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CLINICAL SURGERY

FROM THE WESTERN RESERVE UNIVERSITY

RECONSTRUCTION OF THE VAGINA

EMPLOYMENT OF THE FLAP TRANSPLANTATION METHOD IN ONE STAGE WITH A FAVORABLE ANATOMICAL RESULT

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SURGICAL reconstruction of the vagina in selected cases of congenital or acquired absence is a problem which has been attacked by a variety of operative methods. The early attempts to form the vagina by transplantation of adjacent skin surfaces as free grafts covering the walls of an opening made in the rectovaginal space universally resulted in failure owing to scar tissue contraction. The operative procedures employed have resolved themselves into three groups: (1) resection of the rectum and employment of a resected piece of rectum (Schubert); (2) resection of a loop of small bowel (Baldwin); (3) transplantation of skin flaps (Graves, Frank, Geist, et al.). Pemberton has very adequately summarized the situation in his survey of methods employed up to date. Dupuytren is credited as having made the first reported attempt to form an artificial vagina in 1817. Many different methods have been tried since; notably, free skin flaps, Thiersch grafts, and intestinal wall as free grafts, and all of these have been unsuccessful. Gersuny and Puppl preceded Baldwin, who described his method in 1904 and carried it out in 1907. Mori performed practically the same procedure in Japan.

The next advance was Schubert's resection of the rectum and its employment as vagina in 1911. By this method the distal rectum is mobilized inside the sphincter, resected at an appropriate length, and drawn in to form a lining for a previously made opening in the rectovaginal septum. The upper segment is drawn down and attached inside the sphincter, thus restoring the continuity of the large bowel. According to Pemberton's report, Schubert had collected 34 cases up to 1921 with a mortality of 12.5 per cent. Two deaths were due to peritonitis, although the operation is presumably carried out extraperitoneally.

The Baldwin operation has produced, in 79 reported cases, quoted by Pemberton, a mortality of 17.5 per cent. The admonition that only experts should perform this operation is invalid as no one is apt to see enough cases to acquire an adequate technique. High mortality rates are apparently not the only contra-indication, partial incontinence of fæces frequently resulting after Schubert's method. Annoying discharge has been noted as a complication where intestine is transplanted in forming an artificial vagina. Ritchie reports an adenocarcinoma developing in a transplanted loop of small bowel (Baldwin operation). This must be considered, as the tendency toward malignancy in transplanted or misplaced tissue is well known.

The tendency recently has been toward the third method, i.e., transplantation of skin flaps. Mobilization of healthy flaps composed of skin of the inner surfaces of the thighs, and employment when feasible of the labia minora as all or a portion of the vagina, has come to be more frequently tried than the radical procedures of bowel resection. The mortality rate is reduced by this method to a negligible level, and the operation can be performed with relative ease. The end-result of any technique for reconstructing the vagina is somewhat problematical, and it seems doubtful whether subjecting a patient to a high mortality risk is justifiable. The technique of the skin flap transplantation devised by Graves, described in his textbook and employed successfully in 1 case, has been the basis of several similar procedures. He used four racket-shaped flaps to fill a cavity made by blunt dissection between the vagina and rectum, obtaining two of the flaps from the medial surfaces of the thighs, and two from the labia minora. The flaps were sutured together over a glass form and invaginated into the cavity. The

method, if properly performed, is effective, although prone to contraction until healing has taken place.

Frank and Geist have devised a plan of producing a tubular skin flap and this has been successful in several cases. A tubular graft is made in stages from the skin of the inner surface of the thigh. This is gradually freed and, becoming well vascularized from its pedicle alone, is eventually turned in to form a lining for the prepared opening. It is necessary of course to perform this procedure in stages, but the nutrition of the tubular flap is well preserved thereby and the liability of sloughing is reduced. Modification of the same principle, i.e., the construction in numerous stages of a well nourished tubular flap also from the inner aspect of the thigh, has recently been reported by Grad. These methods, however, require multiple operations—a serious disadvantage. Davis and Cron described a technique employing the principle of Graves' operation, using two flaps prepared entirely from labia minora. This method, consisting of immediate transplantation of thick flaps with broad bases, is a simple procedure possible of performance in one stage, but subject to the danger of distal ischæmia of the flap, with subsequent contraction, especially at the apex of the new vagina. This operation was performed in a single case coming under our observation, with an excellent plastic result.

CASE REPORT

The patient was an 18 year old white female who entered the Lakeside Hospital August 2, 1931, with a diagnosis of acute appendicitis. Immediate appendectomy was performed. An attempted pelvic examination at this time revealed complete absence of the vagina. The labia minora and labia majora were rather small. The clitoris was slightly larger than normal in size (see Fig. 1). Upon rectal examination the uterus also was found to be apparently missing. There had been no menstruation and a complete absence of menstrual molimena. Rectal examination under anæsthesia revealed in the right adnexal region an ovoid mass, firm and freely movable, apparently the right ovary. This was slightly larger than normal in size. The vaginal orifice showed a small dimple at the normal site of the vagina, approximately 1 centimeter deep, the bottom of which was solid. The patient was a well developed, well formed, attractive girl with normal development of the breasts. There was normal distribution of hair and apparently typical feminine habitus in all respects. The patient had no subjective symptoms suggestive of any cyclic menarchal activity. She was not tested for female sex hormone.

The situation was explained to the patient and it was suggested that after successful plastic operation it might be possible for her to marry and lead a normal social life. The patient's psychosexual reactions toward the male were typically feminine.

Operation. A transverse skin incision was made in the area between the rectum and the urethra,

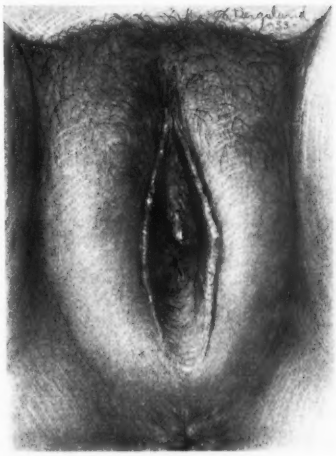

Fig. 1. Perineum before operation.

which were in exceedingly close approximation. A sound was placed in the urethra, which was held by an assistant, and the index finger of the left hand was placed in the rectum. By blunt and sharp dissection a cavity was made, the length of the index finger, between the bladder and the rectum, which corresponded in position with the normal vagina. Sufficient retraction was obtained to permit much of this to be done under sight. Several vessels were of sufficient size to make ligation necessary. The cavity was made and dilated to admit two fingers with slight difficulty. The immediate proximity of the rectum and urethra made greater dilatation seem dangerous. The peritoneum was visualized at the apex of the pouch so made. Two sutures were placed firmly in the apex of the false passage made between the rectum and the bladder. The labia minora were excised from above downward, then split and flattened out, producing racket-shaped pedicle flaps. A rather large pedicle was left for attachment to insure fair blood supply (Fig. 2a); these were used as the two upper flaps. At a level just above the base of the posterior surface of the new vagina, two racket-shaped flaps, 4 inches in length and 1.5 inches in width, were prepared on rather broad pedicles, from the inner margin of the skin of the thigh. These areas showed a minimum of hair growth. An everted pocket was easily formed by suture of these four flaps turned on their pedicles in the manner suggested by Graves and by Davis and Cron, although the latter employed the labia only (Fig. 2b). The sutures originally placed in the depth of the cavity were passed through the

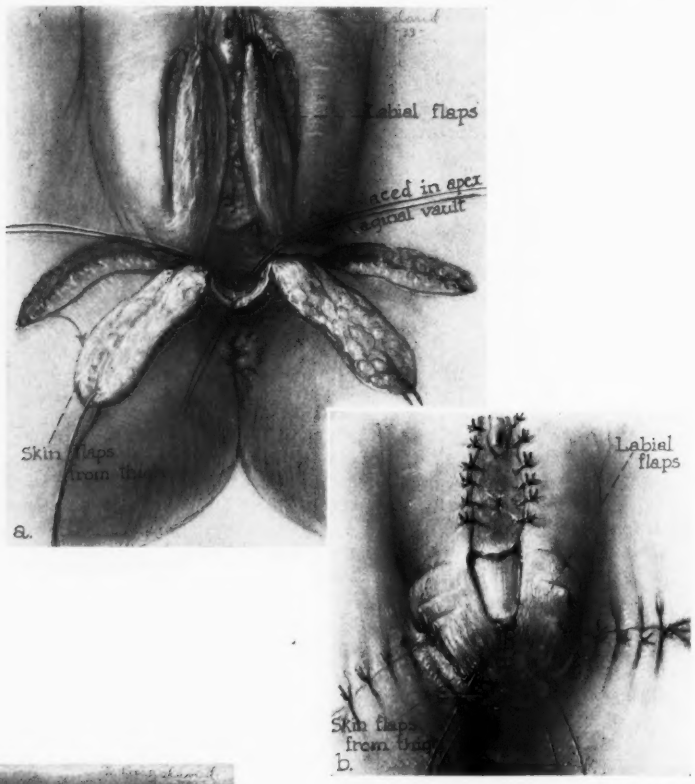

Fig. 2. a, Skin flaps mobilized. b, Partial suture of flaps forming everted vagina.

Fig. 3. The flaps have been sutured and have been drawn into place.

Fig. 4. Appearance of vagina admitting 2 fingers to a point above the knuckles.

apex of the everted lining and this was turned into the vagina and held firmly by tying the sutures, a single end of which was passed through each of one of the four flaps (Fig. 3). The vagina was packed with vaseline gauze. A retention catheter was kept in the bladder until the twelfth day after operation. The gauze was removed on the second day after operation; additional examination was done on the eleventh day following subsidence of swelling. At the time of the patient's discharge from the hospital, 1 month from date of operation, the vagina was as long as the index finger. There was an area of granulation at the apex of the vaginal canal which could be felt as a rough area and it was impossible to insert two fingers without causing pain. This patient was kept under observation for a year and examined regularly for 6 months until the period of rapid contraction was over. The vagina was systematically dilated by digital examination every 2 weeks and by daily passage of dilators 3 to 4 centimeters in diameter by the patient. One year after operation the patient had a vagina 3.5 inches in length, admitting two fingers freely, potentially longer due to the fact that there is a great deal of resiliency and "give" in the new vagina without pain (Fig. 4). This patient is still single but has a fairly normal vagina capable of reasonably normal function. There is apparently normal clitoris sensibility. It was impossible to determine any transfer of erogenous sensibility to the recently constructed vagina. However, high digital dilatation of the vagina without palpating of the clitoris was characterized by the patient as vaguely pleasant. Tendency toward scar tissue contraction seemed to have disappeared.

CONCLUSIONS

Plastic construction of the vagina by transplantation of plastic skin flaps seems to be preferable to more dangerous gut transplantation operations, if only on the basis of comparative mortalities. In spite of vigorous championship of gut resection methods by originators of various techniques it seems preferable that good results be sought after by careful and painstaking transplantation of the thigh skin and labia minora, in the form of pedicle grafts. The sole, but highly important objection to this safe, easily performed procedure is, of course, contraction, which can be reduced to a low level by care in the planning and execution of the operation.

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ACUTE OSTEOMYELITIS OF THE ILIUM

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ACUTE osteomyelitis of the ilium is represented by a relatively short bibliography covering the last 30 years. This would lead one to believe that the disease is rare. While the condition is by no means common, its occurrence does not deserve surprise. Geist, during a period of 5 years, saw 3 acute and 2 chronic cases of osteomyelitis of the ilium; he concluded that the affection was not so rare as is generally supposed.

It is, of course, well known that acute osteomyelitis of the short and flat bones is much less frequent than that of the long bones. Froehner, in analyzing 545 cases of osteomyelitis, found that 51 of them were of the short and flat bones; a ratio of 1:12. He further noted that in these 51 cases of short and flat bone osteomyelitis, the ilium was next to the clavicle in frequency of involvement.

At the 1925 Russian Surgical Congress in Leningrad, Krasnobajiv reviewed 428 cases of osteomyelitis treated in 20 years. Twenty patients had osteomyelitis of the ilium; that is, 5 per cent of the total number. Buosanti reviewed 170 cases of osteomyelitis treated during a period of 14 years; of these 4 were acute osteomyelitis of the ilium, 2.3 per cent. Simmons reported 2 cases of a total of 97 cases of osteomyelitis studied, 2.05 per cent. Bearse gave the frequency of occurrence as 2 to 7 per cent of all bones; Flickinger reported the same figure. Both Bearse and Flickinger stated that osteomyelitis of the ilium comprises 20 per cent of all flat bone infections.

If acute osteomyelitis of the pelvic bones alone is considered, it is found that the ilium is much more frequently involved than the pubis and ischium. Monsaingeon states that "it is located most often in the ilium, sometimes in the pubis, very rarely in the ischium." He was able to compile 11 cases involving the ilium during a period of 13 years in the Infantile Surgical Clinic of the Faculty of Paris. VonBergmann collected 71 cases of osteomyelitis of the pelvis; of these 63 were of the ilium alone. Thomschke concluded that primary osteomyelitis of the pubis and ischium is a rare disease.

From a review of the literature, we can draw the following conclusions as to the frequency of occurrence of osteomyelitis of the ilium: It comprises about 5 per cent of all osteomyelitis, it is the most frequently affected *flat* bone accounting for about 20 per cent of all flat bone osteomyelitis, that of the bones of the pelvis it is by far (8:1) the most common site for the disease.

During the past 5 years, 11 cases of osteomyelitis of the ilium have been treated in this clinic. Of these 5 have been chronic; 2 were metastatic during the course of acute osteomyelitis in long bones, and 1 was a tuberculous osteomyelitis. These cases are not included in this report as they present different problems both as to diagnosis and treatment.

The 3 following cases of acute primary osteomyelitis of the ilium illustrate the difficulties of diagnosis, the common confusion of the disease with pyogenic infection of the hip joint, the problems encountered in treatment, and the long continued course of the malady. The two surviving cases show the end-result 2 years and 9 months, respectively, after onset. Of the case reports found in the literature, very few include the end-result for any considerable length of time after onset. It is hoped that the reports below may be of some help in determining the ultimate prognosis in similar cases.

CASE REPORTS

CASE 1. I.S., S.M.H. No. 212, a Jewish boy, aged 16 years, entered Strong Memorial Hospital, February 27, 1926. He complained of pain in the right hip, right great toe, and sternoclavicular joint; weakness and shortness of breath. Eleven days before entry the patient went skating. On returning home he complained of pain in the right hip. That evening he had chills and vomited. The next day he was feverish and complained of generalized dull aching in all his joints. On the third day of his illness his mother noted that his urine was red and on the sixth day it was black. During this same period his skin became yellow and he began to be short of breath. His bowels were quite loose, the fæces were black in color. He had 3 hæmorrhages from the nose; the last of which lasted 6 hours. On the ninth day of the illness he began to complain of pain in the episternal notch and right great toe. He developed very small, red papules over the lower limbs. During the illness he had been seen by several physicians. His temperature had always been 103-104 degrees F. He had continued throughout the illness to complain of pain in the right hip. He entered the hospital by stretcher on the eleventh day of his illness.

Physical examination on entry revealed a boy very acutely ill, with temperature 39.5 degrees C. He lay in bed appearing exhausted. He was breathing at the rate of fifty times per minute. The breath was sour and the tongue was heavily coated. The conjunctivæ were pale; the skin and scleræ slightly icteric. The nose contained dried crusts of blood. The heart was enlarged. There was a palpable and

audible pericardial friction rub. The pulse was regular, 130 per minute. The blood pressure was 118/40. There was widening of the mediastinal dullness to 10 centimeters in the second intercostal space. The lungs were clear. The spleen and liver were both enlarged and tender. Rectal examination showed no masses. Over the lower limbs there were numerous small, red, raised papules, with purulent centers. In the episternal notch there was a small red swelling which was very tender. The metatarsophalangeal joint of the right great toe was swollen, red, tender, and painful on motion.

The region about the right hip joint was tender to palpation. There was no visible or palpable swelling. The lower extremity lay on the bed in normal position. The joint could be moved passively throughout almost its complete range of motion with almost no pain. No muscle spasm was found.

Laboratory examination revealed: hæmoglobin, 40 per cent; red blood cells 2,200,000; white blood cells, 50,000. Differential count showed 97 per cent polymorphonuclears. The urine was cloudy, brown, with trace of albumin, no sugar. Microscopic examination showed many red cells and granular casts. Blood culture; hæmolytic Staphylococcus aureus. Culture from papule on lower extremity showed the same organism. Wassermann reaction was negative; Widal, negative. X-rays of the chest showed a hypertrophied and dilated heart.

The day after admission the swelling in the episternal notch became fluctuant. It was incised and 150 cubic centimeters of thick pus drained off; Staphylococcus aureus was recovered from this on culture. Following this the patient was transfused with 400 cubic centimeters of citrated blood. The next day he was given by the medical service 300 milligrams of gentian violet in solution intravenously without reaction. On the following day, he seemed improved and the temperature was slightly lower. It was decided to withhold another transfusion or tapping of the pericardium until the temperature should swing up again. That night the patient suddenly became very dyspnœic and distended. The distention recurred as quickly as it was relieved. Stimulants were of no avail. Within an hour he was dead.

Postmortem examination disclosed the following: There was a large abscess in the upper mediastinum which had been drained but still contained 75 cubic centimeters of pus. There was an abscess under the left pectoral muscles. The pericardial cavity contained 60 cubic centimeters of yellow cloudy fluid. There was a thick fibrinous pericarditis. The lower lobes of both lungs showed a typical compression atelectasis. The spleen was about five times normal size and contained a large infarct. The liver was enlarged by about half, but contained no abscesses. Both kidneys contained innumerable miliary abscesses. The lymph nodes at the hilus of the lung and the retroperitoneal lymph nodes were greatly swollen. On the right side of the true pelvic cavity the wall was seen to bulge. Incision of this exposed a large abscess. It was found to come from beneath the iliacus muscle and to overlie an extensive osteomyelitis of the entire wing of the right ilium. There was a great deal of bone destruction. The cortex of the ilium was moth-eaten with the underlying bone soft and necrotic. The lesion in the iliac bone was interpreted as being the oldest.

The final diagnosis was acute primary osteomyelitis of the right ilium followed by Staphylococcus aureus septicæmia with subsequent metastases to the pericardium, mediastinum, spleen, kidneys, left subpectoral region, and metatarsophalangeal joint of the right great toe.

The first case is that of a boy of 16 years who, following a probable trauma sustained while skating, complained of pain in the right hip. He rapidly developed the signs of an overwhelming blood stream infection. On examination 11 days after onset the boy was seen to be desperately ill. The temperature was 39.5 degrees C.; white blood cells 50,000. He was very anæmic. There was an abscess pointing in the episternal notch. Signs of pericarditis were present. The liver and spleen were enlarged. The right great toe was swollen and red. There was tenderness to palpation about the right hip but all motions were free and without discomfort. The mediastinal abscess was drained; he was transfused but failed to improve. He died on the sixteenth day after onset. The diagnosis of osteomyelitis of the ilium was not suspected during life. At postmortem, the oldest lesion found was an acute osteomyelitis of the ilium with a large abscess in the iliac fossa.

Case 2. S.G., S.M.H. No. 51145, Italian boy of 5 years, was admitted to the Strong Memorial Hospital August 30, 1931. His complaint was pain in the right hip. Five days before entry the patient fell while playing. He struck on the right hip and complained immediately of pain in that region. He limped around the rest of that day but that evening felt feverish and refused to eat. For 4 days following injury he did not walk because of steadily increasing pain in the hip. He continued to feel feverish.

Physical examination showed a thin boy of 5 who was apprehensive and irritable. He was acutely ill. Temperature was 40.6 degrees C.; pulse, 130; respiration, 30. The skin was warm and flushed. The tonsils were large and somewhat injected. The lungs were clear. The heart was normal except for a soft apical systolic murmur. The abdomen was distended and tympanitic. Rectal examination was negative.

The patient refused to move the right lower extremity because of pain in the hip. There was a suggestion of fullness above the greater trochanter but there was no redness or increased local heat. There was no hip flexion or abduction contracture present. There was marked tenderness on palpation about the region of the greater trochanter and superior to it. All motions of the hip were greatly limited by pain but the extended extremity could be rotated if this were done gently and slowly.

Laboratory examination revealed hæmoglobin, 60 per cent; white blood cells, 12,500. The urine was slightly cloudy, yellow; reaction, acid; no albumin or sugar. Microscopic examination showed only a rare pus cell. Wassermann reaction was negative. Blood culture on entry was positive for hæmolytic Staphylococcus aureus. X-rays on entry were normal in appearance (Fig. 1).

On the day of entry the right hip joint was opened through a posterior Ober incision. When the joint capsule was opened there was an escape of 20 to 30 cubic centimeters of seropurulent fluid. A culture of this fluid grew hæmolytic Staphylococcus aureus. Rubber drains were inserted down to the capsule and wound left wide open for drainage. Extremity placed in traction with hip slightly flexed.

The boy remained desperately ill for 10 days. The temperature remained around 40 degrees C.; he was drowsy and at times irrational. He was sustained by direct blood transfusions, intravenous glucose, and fluid by hypodermoclysis.

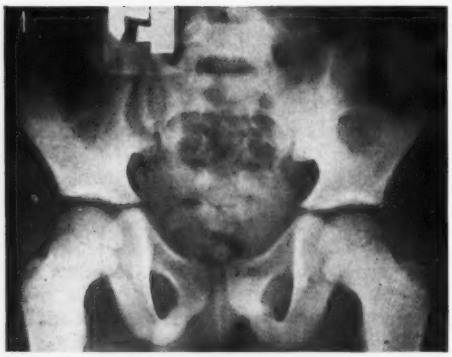

Fig. 1. Case 2. Normal appearance of right ilium and hip joint at onset.

Fig. 2. Case 2. Extreme destruction of right ilium 1 month after onset.

Fig. 3. Case 2. Appearance of right ilium following partial resection 1½ months after onset.

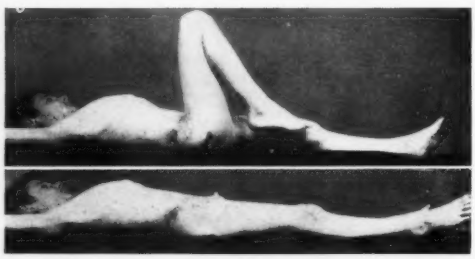

Fig. 5. Case 2. Patient 2 years after onset showing normal flexion and extension of hip. All other motions of the hip are equally normal. Wounds healed completely without sinuses.

Fig. 4. Case 2. Two years after onset showing regeneration of ilium except for one small area, moderate upward and inward displacement of the acetabulum. The roof of the acetabulum is roughened. With this exception, the hip joint appears normal.

At the end of this time the temperature came down to normal quite rapidly and the patient's general condition improved remarkably. He seemed well on the way to recovery. One month after entry the operative wound had completely healed and there was practically a normal range of motion in the hip joint. X-rays were taken at this time to determine the condition of the joint. They revealed an extensive osteomyelitis of the right ilium; the joint did not appear to be damaged. Previous to the taking of these X-rays, osteomyelitis of the ilium had not at all been suspected (Fig. 2).

A few days later partial resection of the ilium was done. An anterior Smith-Petersen incision was used. The origin of the muscles from the crest of the ilium was cut loose and the flap turned down subperiosteally. The greater portion of the wing of the ilium was found to be rough and honeycombed. The bone was quite soft and could be easily removed with a curette. The central portion of the wing was removed in its entirety and considerable necrotic granulation tissue was found on the pelvic side. The superior rim of the acetabulum and the periphery of the ilium were left

intact (Fig. 3). The wound was packed with vaseline gauze; the extremity was placed in traction with the hip flexed slightly. Culture from the ilium grew Staphylococcus aureus. Microscopical sections of the removed bone showed a subacute osteomyelitis. Convalescence following this procedure was long but steadily uphill. The wound continued to drain moderately. Five months after partial resection of the ilium, an abscess accumulated under the gluteal muscles and had to be drained. The patient was followed with X-rays at frequent intervals and the ilium was seen gradually to regenerate. He was discharged 7 months after entry to a convalescent home for care. On discharge there was still a small draining sinus from the ilium.

Fourteen months after onset of his illness the boy was walking with crutches. The right lower extremity was 1 centimeter shorter than the left. X-rays showed complete regeneration of the ilium except for one small area. The acetabulum was somewhat roughened and displaced slightly upward and inward changing the contour of the pelvic cavity (Fig. 4). There was still a small draining sinus. Two years after onset of the illness he was walking normally except for a very slight limp. The sinus has healed. There is a normal range of motion in the hip joint (Fig. 5).

The second case occurred in a boy of 5. He had fallen on his right hip and following this complained of pain in the hip and inability to walk. The following points were noted in the examination 5 days after onset: He was acutely ill; temperature 40.6 degrees C.; white blood cells 12,500. There was marked tenderness about the right hip joint. All motions of the hip were limited and painful but the extended limb could be rotated if this were done slowly and gently. The diagnosis of pyogenic infection in the hip joint was made and confirmed by drainage. One month later X-ray films showed extensive destruction of the right ilium. The affected portion of the ilium was resected. One year later the ilium had regenerated. Two years after onset, the right lower extremity is 1 centimeter shorter than the left due to upward displacement of the acetabulum. The boy is walking normally except for a very slight limp. There is normal range of motion in the hip joint; all sinuses have healed.

CASE 3. H.S., S.M.H. No. 66232, white boy of 14 years, entered Strong Memorial Hospital October 5, 1932. He had pain in the left hip. Two days before entry the patient had awakened with slight pain in the left hip. He went to school. The pain became worse and he began to have headache. He was sent home by the teacher. That afternoon he had a severe chill and went to bed. The rest of the day he felt alternately hot and chilly and the pain in the hip became more severe. The next day he remained in bed most of the time. He attempted to get up but was able to walk very little because of pain in the left hip and thigh. He had another severe chill about noontime. The pain in the hip, headache, fever, and chills continued. He was brought to the hospital on the third day of his illness. Patient had had a running ear 2 years previously, otherwise the past history was non-contributory.

Physical examination revealed an acutely ill appearing boy with temperature 40 degrees C.; pulse, 120; respiration, 25. The face was flushed and hot. The lungs were clear. The heart was normal. The abdomen was soft and no tenderness or masses were made out. Rectal examination was negative except for moderate tenderness on the left side on pressure on the bony wall of the pelvis. The left hip was held slightly flexed. There was no pain on flexion or extension of the hip. The extended extremity could be passively rotated freely and without discomfort. There was pain on abduction of the hip. There was diffuse tenderness about the hip joint and pelvis on the left. This was most marked over the superior ramus of the pubis.

Laboratory examination revealed hæmoglobin 95 per cent; red blood cells, 5,700,000; white blood cells, 15,600; polymorphonuclears, 75 per cent. The urine was clear, amber; reaction, acid; specific gravity, 1.015; no albumin or sugar. Microscopic examination showed only an occasional epithelial cell. X-ray films on admission were normal (Fig. 6).

Three observers thought the boy probably had an osteomyelitis of the pubis. A senior member of the staff interpreted the signs as being those of an early suppurative process in the left hip and advised drainage of the joint.

On the day of admission the left hip joint was opened by anterior approach. The joint appeared perfectly normal. There was no excess fluid. The synovium was not inflamed, no flecks of fibrin were noted. A culture was taken from the surface of the head and neck of the femur and the wound was closed without drainage.

The boy continued to run a high septic fever ranging between 38.5 and 40 degrees C.; he remained acutely ill. On the second postoperative day a flexion and abduction contracture of the hip began to develop. He was placed in traction in the line of deformity to overcome this. On this day he was seen in consultation with Dr. J. J. Morton, chief of surgery, who said he suspected that the boy had an acute osteomyelitis of the ilium.

On the fifth day after operation, the wound was red, indurated, and tender and on this day culture which had been taken from the hip joint at operation showed a growth of hæmolytic Staphylococcus aureus. The white blood count was 18,300. Blood culture which had been taken on entry also showed a growth of Staphylococcus aureus at this time.

It was felt that the boy's illness was probably due to a pyogenic infection in the left hip joint, which the operator had been unable to recognize at the original exploration because of the short duration of the infection.

Accordingly the wound was reopened under gas oxygen anæsthesia. On separating the subcutaneous tissues 10 to 15 cubic centimeters of thick pus escaped, which culture later showed to contain hæmolytic Staphylococcus aureus. The joint was opened and drains inserted down to the capsule. The wound was left wide open for drainage.

Following this procedure the patient was much improved. He became brighter and more alert. The temperature dropped from previous high level but remained definitely septic in type ranging between 37 and 38.5 degrees C. daily. X-ray films on the twenty-first day of illness showed definite osteomyelitis of the left ilium (Fig. 7). On looking back over X-ray films taken on the seventh and tenth days after onset, it was noted that the beginning abnormalities in the X-ray pictures could, without question, be seen as early as the tenth day after onset.

At this time the patient was no longer dangerously ill although he was having daily rise of temperature to 38.5 degrees C. There was no tenderness over pubis or ilium. The wound into the hip joint was still draining slightly. The white blood cell count was 12,000.

One month after onset of the illness the wound into the hip joint had completely healed and there was normal range of motion in the joint. X-ray films at this time showed that

Fig. 6. Case 3. Normal appearance of left ilium and hip joint at onset.

Fig. 7. Case 3. Moderate destruction of the left ilium 3 weeks after onset. The process involves the roof of the acetabulum and extends upward to the anterior superior spine.

Fig. 8. Case 3. Appearance of left ilium following partial resection 1 month after onset.

Fig. 9. Case 3. Appearance of the ilium 9 months after onset. There has been complete regeneration of the portion removed. The hip joint has been moderately involved as is shown by the narrowing of the joint space.

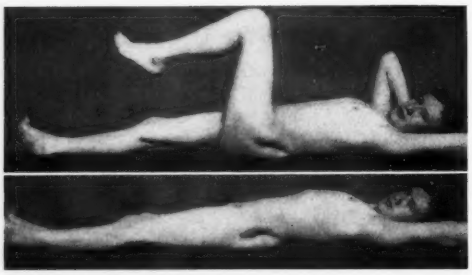

Fig. 10. Case 3. Patient 9 months after onset. Flexion and all other motions of the hip limited about 10 per cent. Wounds completely healed. No sinuses present.

there was a progression of the destructive process in the iliac bone. Because of this it was thought wise to resect the diseased portion of the ilium.

An incision was made from the greater trochanter up to the anterior superior spine of the ilium and curving backward along the iliac crest. The origin of the gluteal muscles was cut loose from the crest and the ilium was exposed by reflecting them subperiosteally. The periosteum was thickened and œdematous. The bone from the acetabular rim upward for a distance of about 2½ inches was very soft and friable. It could very easily be removed with a curette. No free pus was found. The full thickness of the ilium was removed until the visceral periosteum was in view. All soft bone was removed until healthy bone was left (Fig. 8). The wound was left wide open; the muscle flap was packed back with large packs of vaseline gauze. Culture from this area showed Staphylococcus aureus. Sections of the bone revealed a subacute osteomyelitis.

Following this procedure the patient gradually improved. The wound drained profusely at first but this gradually diminished until at the end of a month there was no evidence of a sinus. The temperature gradually became normal over the course of a month and a half.

Two months after resection of the ilium it was necessary to drain an abscess under the original incision into the hip joint. Culture of this proved it to be sterile.

The patient was discharged from the hospital 6½ months after entry. He was walking with crutches without bearing weight on the left side.

Nine months after the onset of his illness X-ray examination showed that the affected area in the ilium had filled in with new bone. The joint space of the left hip was somewhat narrow and the acetabulum was displaced slightly inward (Fig. 9). The boy has a practically normal range of motion in the left hip joint, all motions being limited about 10 per cent. The wounds have completely healed without sinus formation (Fig. 10). He is still being made to walk with crutches without weight-bearing on the affected side.

The third case was that of a boy 14 years old, who without antecedent trauma, began to complain of pain in the left hip. He had chills and fever and was unable to walk because of pain in the hip. Examination on the third day of his illness showed that he was acutely ill; temperature 40 degrees C.; white blood cells 15,600. There was marked tenderness about the left hip, particularly over the pubis. All motions of the hip were free and without discomfort except for abduction. The hip joint was opened and found to be negative. Five days later it was necessary to reopen and drain the hip joint. X-ray films 3 weeks after onset showed destruction of the left ilium. The affected portion of the ilium was resected. Nine months later the boy was walking with crutches. There was practically normal range of motion in the hip joint. The wounds have completely healed without sinuses.

DIAGNOSIS AND TREATMENT

The diagnosis of acute osteomyelitis of the ilium is by no means easy. This is, perhaps, partly because the physician fails to remember there is such a disease. On the other hand, the patient may present such a preponderance of constitutional symptoms that little attention is paid to the initial local complaint. This was true of the first case herein reported.

There is in a majority of patients a history of preceding trauma to the pelvis. The child complains for a few hours of pain in the hip and thigh, following a fall. There is then an onset of malaise, fever, and perhaps chills. The pain in the hip becomes progressively more severe and the patient is unable to bear weight on the affected side; walking is impossible because of pain.

If the physician sees the patient at this stage of the illness, he will, after obtaining a history similar in most respects to the above, note the following points on examination. The child will be acutely ill, the temperature will be elevated, there will be extreme tenderness to gentle palpation about the hip joint. (Bearse says that the greatest point of tenderness is usually above and posterior to the greater trochanter.) On determining the range of motion in the hip joint, he will be surprised to find that there is a much freer range of motion than he had expected, and little in the way of muscle spasm.

After these findings the physician will probably be non-plused and the diagnosis, as far as the family is concerned, will be "acute rheumatism, sciatica, sprain of the hip, or some such condition," but with a mental question mark on the physician's part. Heat will be applied to the hip and watchful waiting will be the course pursued.

At the end of about a week the physician will find that the patient is no better; in fact, he will probably be considerably worse. He will still have high fever, he may be irrational or even comatose. If he is so desperately ill that the constitutional symptoms completely obscure the initial complaint of pain in the hip, the diagnosis will now be changed to meningitis, typhoid fever, generalized septicæmia; (mistakes in diagnoses in fulminating cases frequently mentioned in the literature) or some other severe constitutional infection.

On the other hand, if the child is still alert enough to respond to painful stimuli, it will be noted that the tenderness about the hip is definitely greater in severity and that now there is fairly marked spasm of the thigh muscles. All motions of the hip will be painful and limited, but if motions are carried out slowly and gently, it will be found that free motion is present. This is especially true of rotation of the extended extremity, according to Holmes.

If, at this point, the physician becomes alarmed and calls in a surgical consultant, the diagnosis will be cleared up at once. The surgeon will wonder how the physician could have been so stupid as to call this picture anything except a pyogenic infection in the hip joint. The patient will be taken to a hospital and the hip joint will be incised. At operation a small amount of seropurulent fluid will be found in the joint cavity and drainage will be instituted. Culture from this fluid will further substantiate the diagnosis by growing Staphylococcus aureus. Everybody's mind will be at ease.

The patient will now probably improve to a certain extent, but the surgeon will wonder why the fever continues to be septic in type. At the end of 3 or 4 weeks, X-ray films will be taken to determine the condition of the hip joint, and much

to everyone's surprise, there will be a full-blown osteomyelitis of the ilium.

If the fates are kind and the surgical care is adequate, the patient will be walking again in a year or two, possibly with a small draining sinus from the wound through which the dead bone of the ilium was removed.

We have told this story because it is typical of most of the cases reported in the literature, and because the 3 cases reported here do not materially differ from it. In the first case the constitutional symptoms of a severe septicæmia with numerous metastases so occupied attention that the diagnosis of acute osteomyelitis of the ilium was not made until postmortem. In the second case, the child was first seen nearly a week after the onset of the disease and the signs pointed so strongly to the hip joint that it was opened and drained. The culture of the small amount of seropurulent material drained was positive for Staphylococcus aureus but osteomyelitis of the ilium was not suspected until the X-ray pictures revealed it a month later. The third boy was seen earlier; on the third day after onset. But even though osteomyelitis of the pelvic bones (it is true, not of the ilium) was suspected and motion in the hip was free, still the hip joint was explored at the direction of a senior staff member and the diagnosis not made until 3 weeks later when the X-ray showed beginning destruction of the ilium.

Now why is this sequence of events of common occurrence? It is purely because of the anatomy of the ilium. The ilium is a flat bone; as such it has a relatively thin cortex in comparison with long bones. It, moreover, has no medullary canal. In addition, in the young pelvis, the roof of the acetabulum is tripartate and thinly clad with cartilage. The pathology of infection in a flat bone is consequently different from that of a long bone.

There is, with the increase of tension inside the bone which accompanies the inflammatory process, an early perforation of the cortex which does not occur until late in long bone osteomyelitis. These perforations of the cortex produce the so called "mottled or moth-eaten" appearance in the X-ray negatives, characteristic of flat bone osteomyelitis.

In the ilium these perforations may occur anywhere but predominantly in one of three places; the internal iliac fossa, the external iliac fossa, or through the acetabulum into the hip joint. In children, because of the anatomy, the disease invades the acetabulum early. In adults, an abscess forms more often under the iliacus muscle in the internal fossa or under the gluteal muscles in the external fossa.

It is, therefore, easy to understand why in children real spasm of the hip muscles with limitation of motion is found if the patient is seen late in the course of the disease.

From the natural history of the disease and an understanding of the pathological changes incident to infection in flat bones, a few points can be drawn which we believe may be of aid in diagnosis and treatment.

If a child complains of pain in the region of the hip following a trauma to the region, and on examination is found to be acutely ill with high fever, leucocytosis, tenderness, and increased local heat about the hip, but relatively free motion of the hip joint; then osteomyelitis of the ilium should be suspected. This, we believe, is so because: (1) The pain of infection in the hip joint is often, although not always, referred to the knee. In osteomyelitis of the ilium, the pain is always about the hip with oftentimes inability on the part of the patient to localize definitely the site of discomfort. In none of the cases reported nor in our cases has pain been referred to the knee. (2) Flexion and abduction contracture occurs very early in septic involvement of the hip joint; in osteomyelitis of the ilium no contractures are present until later. (3) Pyogenic infection in the hip joint manifests itself early by almost complete fixation of the hip joint due to muscle spasm, in osteomyelitis of the ilium in the first few days of the disease, motion in the hip is free. (4) If osteomyelitis of the pelvic bones is suspected then the ilium is the bone by far the most likely to be affected. Acute osteomyelitis of the pubis and of the ischium is so rare that it is hardly necessary to give it consideration.

If the diagnosis is made, then what should be the treatment? Scott believes that "palpable masses in and outside the pelvis are watched for and surgical drainage promptly done if they are found. The construction of the iliac bone predisposes to rupture to the visceral side and, therefore, it is to this side that we may expect to locate the pocketing of escaped pus rather than to the outer side. No radical surgery has seemed necessary and apparently the less radical surgery done the better for the patient. We would like to discourage radical procedures as we believe them not to be needed. The true osteomyelitis seems rather a self-limited problem in the pelvis and yields readily to proper drainage." Short states: "it seems better in the acute stage to drain down to the bone, but not into it, as pus has not yet formed; opening up the cancellous bone predisposes to septicæmia by opening up the veins in the cancellous spaces to infection."

Skillern says in a case reported in 1917: "It was thought that trephining the bone would not only evacuate the iliac abscess but also open up the spaces in the cancellous bone of the dorsum of the ilium, just as in the mastoid operation." We believe this to be very rational treatment for the following reasons.

By far the most frequent complication of osteomyelitis of the ilium mentioned in the literature, and we agree, is invasion and destruction of the hip joint. If this be so then it seems that treatment should be directed toward saving the patient's life, and secondly preventing destruction of the hip joint. Most of these patients have a blood stream infection from the beginning, all 3 of our patients had positive blood cultures of Staphylococcus aureus. Free drainage and decompression, we believe, should then be established as soon as possible. It is true that perforation takes place early which drains the infected bone, but if we can surgically produce this perforation earlier we have done three things: (1) we have decompressed the cancellous bone which is the focus for the septicæmia, (2) we have attempted to prevent spontaneous perforation with abscess formation on the visceral side of the ilium which is more difficult to handle, and (3) we have attempted to prevent invasion of the hip joint.

We, therefore, think that if the diagnosis can be made early that the gluteal muscles should be reflected subperiosteally from the ilium after the manner of Smith-Petersen and the bone drilled until pus is found. In this area the cortex should be removed. By so doing an outlet will be allowed for the infection locked in between the two cortical layers. Adequate external drainage will prevent spontaneous perforation through the visceral cortex and downward spread through the acetabulum into the hip joint.

Following this the extremity should be kept in traction with the hip abducted and slightly flexed to prevent deformity of the acetabulum and possible dislocation of the hip. Even though this is diligently carried out, mild deformity of the acetabulum occurs as is shown in Figures 4 and 9. This occurs due to the upward pull of the hip muscles forcing the head of the femur upward and inward into the softened ilium.

If, of course, the patient presents himself late with abscesses already formed in the internal or external iliac fossæ these should be drained as Scott suggests, but we do not believe it is wise to wait for them to form. Internal iliac fossa abscesses should be drained externally by trephining through the ilium. They can be drained extraperitoneally above the inguinal ligament but this does not afford as adequate drainage as entering the bottom of the abscess through the ilium, nor is it as safe because of the danger of introducing the infection into the peritoneal cavity. If there are true signs of hip joint involvement, then the joint must be drained. As to resection of the affected portion of the ilium, we agree with Monsaingeon, Bearse, von Bergmann, and others that this depends upon the extent of the bone involved. If there is much dead bone later in the course of the disease, then this must be removed.

The convalescence is long and oftentimes complicated by recurring abscesses. The patient should be protected from bearing weight on the affected side until there is evidence by X-ray that the ilium has fully regenerated and the hip joint is as normal as one thinks it will become.

The prognosis in acute osteomyelitis of the ilium as regards life is more grave than in the more common form of acute osteomyelitis of the long bones. In Krasnobajiv's series of cases, referred to above, the general mortality was 22.4 per cent while, in the 20 cases of acute osteomyelitis of the ilium, the mortality was 40 per cent. Of Buosanti's 4 cases, 3 succumbed. Kolouch states that "the picture is often one of an intense and rapidly fatal sepsis, in the face of which surgery finds itself quite helpless."

Besides being more dangerous as regards life, the disease is also quite disabling if the patient survives. This is not only due to the sinuses and recurrent abscesses common to all osteomyelitis, but also to the frequent involvement of the hip joint resulting in painful limited motion and, at times, complete ankylosis.

SUMMARY

1. The frequency of acute osteomyelitis of the ilium is about 5 per cent of all osteomyelitis. It is the most frequently affected flat bone, comprising 20 per cent of all flat bone osteomyelitis.

2. Three cases of acute osteomyelitis of the ilium are reported in detail.

3. The difficulties in diagnosis are pointed out, particularly with regard to the differential diagnosis between acute osteomyelitis of the ilium and acute pyogenic infection of the hip joint.

4. In acute osteomyelitis of the ilium there is, early in the disease, free motion in the hip; whereas, in acute pyogenic infection of the hip joint, motion is practically absent due to muscle spasm. The reference of pain is also usually different in the two conditions. Flexion and abduction contracture of the hip occur early in pyogenic infection of the hip joint; much later in acute osteomyelitis of the ilium.

5. The anatomy of the ilium in children predisposes to early invasion of the hip joint. Spontaneous perforation of the cortex occurs early. In adults perforation to the visceral side of the ilium is most common.

6. Treatment early in the disease consists in removing the outer layer of cortex in the infected area. This insures drainage of the cancellous bone and is an attempt to prevent spread of the disease into the hip joint.

7. The prognosis is more grave than in acute osteomyelitis of the long bones.

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A STUDY OF THE VENTRICULOGRAMS IN NINETY-SEVEN CASES OF VERIFIED INTRACRANIAL TUMORS

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THE diagnostic value of pneumoventriculograms is dependent upon the surgical and roentgenological technique employed and particularly upon careful interpretation of the findings. This fact has been repeatedly emphasized by Dandy (4, 5, 6) since his introduction of the procedure in 1918.

The deceptive findings due to insufficient filling of the ventricular system with air, or to other technical errors are well known to those familiar with this method of examination. The present study was undertaken to determine and evaluate the more or less constant and dependable criteria by which localization of intracranial lesions may be determined from ventriculograms. For this purpose only cases in which the lesions had been verified at operation or autopsy were studied. All cases in which the roentgenograms were technically unsatisfactory were frankly discarded. From a total of 390 "tumor suspects" upon whom pneumoventriculograms have been made in this clinic, 97 cases of verified intracranial lesions were selected as being entirely suitable for a critical study. There were a few other cases upon whom ventriculograms were made and in whom at operation lesions were found, but either no tumor tissue was removed or the lesion was not "space occupying," or for some other reason the findings did not seem to warrant the inclusion of the case in this study. This study, then, should afford a true exposition of the ventriculographic abnormalities resulting from lesions in various locations in the cranial cavity.

TECHNIQUE

In most instances, the air was injected into the occipital horn of one ventricle with the patient in the sitting or semirecumbent position in the manner recently described by Davis (8). In a few cases the ventricle needle was introduced through the frontal lobe. A blunt ventricle needle graduated in centimeters and equipped with a three-way stop-cock into which a 10 cubic centimeter syringe fits, was used (14). Air was injected into only one side, that opposite the suspected lesion. If it was impossible to obtain fluid from the ventricle first tried, the needle was then introduced into the opposite ventricle. By introducing air into only one side, one is sometimes able to determine the patency of the interventricular foramina (of Munro) by passage of the air from one ventricle to the other. As much cerebrospinal fluid as possible was replaced by a slightly smaller volume of air, except in cases showing marked ventricular dilatation. In these instances, the amount of air injected varied from 40 cubic centimeters to 150 cubic centimeters and it was always allowed to escape after the completion of the roentgenographic series, unless exploratory operation were to follow immediately.

After injection of the air and closure of the wound, the patient was taken to the X-ray laboratory. In all pneumoventriculograms a flat head

TABLE I

Site	Contralateral dislocation		Localizing deformity or dislocation	Dilatation		Diagnostic value				No. of cases
						Positive		Indeterminate	Misleading	
	Lateral ventricle	Third ventricle		Lateral ventricle	Lateral and 3rd ventricle	Lateralizing	Localizing			
Frontal	16	16	16			6	16	3	1	26
Parietal	6	6	9			1	9	1	1	12
Temporal	14	12	4			10	4	0	2	16
Suprasellar			3	2	0		4	1	0	5
Pineal region			3	9	3		9	1	2	12
Posterior fossa				5	20		20	1	5	26

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TABLE II.—FRONTAL LESIONS

Case	Site	Lesion	Lateral ventricles	Third ventricle	Localizing value
1 U27553	Right frontal	Abscess	Collapse of left. Right dislocated to left	Dislocated to left	Positive Lateralizing
2 U36757	Right frontal	Aneurysm	Pressure deformity of tip of right anterior horn	Normal	Positive Localizing
3 U31458	Right frontal	Abscess	Right displaced to left. Collapse of right anterior horn	Displaced to left	Positive Localizing
4 U25349	Right frontal	Astrocytoma	Partial collapse, right anterior horn. Both ventricles dislocated to left	Dislocated to left	Positive Localizing
5 U34634	Left frontal	Metastatic sarcoma	Collapse of left anterior horn. Both ventricles dislocated to left	Dislocated to right	Positive Localizing
6 U30881	Right frontal	Meningeal fibroblastoma	Collapse of right. Left dislocated to left	Dislocated to left	Positive Localizing
7 U20126	Left frontal	Meningeal fibroblastoma	Pressure deformity of left anterior horn which is dislocated posteriorly. Both ventricles displaced to right	Dislocated to right	Positive Localizing
8 U10723	Corpus callosum and right frontal	Spongioblastoma multiforme	Right anterior horn and body compressed downward	Dislocated to left	Positive Localizing
9 U12093	Left parietotemporofrontal	Huge abscess	Partial collapse and pressure deformity of left. Both displaced to right	Dislocated to right	Positive Localizing
10 U18586	Left frontal	Meningeal fibroblastoma	Pressure deformity and posterior dislocation of left anterior horn. Both ventricles displaced to right	Dislocated to right	Positive Localizing
11 U34638	Left frontal	Small organized aneurysm	Normal	Normal	Misleading
12 U36632	Right parietofrontal	Metastatic carcinoma	Collapse of right. Pressure deformity of left. Dislocation of both to left and downward	Very faint. Dislocated to left	Positive Lateralizing
13 G1525	Within anterior horn of right lateral ventricle	Medulloblastoma*	Tumor shadow visualized in air filled right ventricle	Dislocated posteriorly	Positive Localizing
14 U27329	Right frontal	Spongioblastoma multiforme	Right anterior horn displaced downward	Dislocated to left	Positive Localizing
15 U37235	Left parietofrontal	Astrocytoma	Left collapsed. Right dilated	Dislocated to right	Positive Lateralizing
16 U16383	Midline frontal	Meningeal fibroblastoma	Poorly filled. Right anterior horn displaced to right	Not visualized	Indeterminate
17 U35362	Right frontal	Meningeal fibroblastoma	Collapse of right anterior horn. Left anterior horn displaced downward. Both dislocated to left	Dislocated to left	Positive Localizing
18 U33610	Left frontal	Aneurysm, left middle cerebral artery	Collapse of left anterior horn. Deformity medial border of right, which is dilated and displaced to left	Normal	Positive Localizing
19 U350	Tip of right frontal lobe	Abscess	Incompletely filled; apparently normal	Not visualized	Indeterminate
20 U5657	Left frontal	Spongioblastoma multiforme	Collapse of left anterior horn with posterior dislocation of body. Left dilated	Normal	Positive Localizing
21 U37520	Right frontal	Cholesteatoma	Poorly filled. Right less filled than left. No definite deformity	Not visualized	Indeterminate
22 U34602	Right frontal	Meningeal fibroblastoma	Left not visualized. Right dislocated to left. Deformity of right anterior horn	Questionably visualized in midline	Positive Localizing
23 U21860	Right frontal	Tuberculoma	Pressure deformity of right anterior horn	Normal	Positive Localizing
24 S16825	Left frontal	Spongioblastoma polare	Both dislocated to right	Dislocated to right	Positive Lateralizing
25 U25632	Right frontal	Astrocytoma	Dislocation of both to left, especially right anterior horn	Dislocated to left	Positive Localizing
26 U6637	Left frontal	Spongioblastoma multiforme	Collapse of left. Right dislocated to right	Dislocated to right	Positive Lateralizing

*The authors are aware of the rarity of medulloblastomata in the cerebral hemispheres as well as of spongioblastoma multiforme in the cerebellum (Case 78, Table VII). However, the sections in both of these cases have been re-examined and the diagnoses are believed to be correct.

TABLE III.—PARIETAL LESIONS

Case	Site	Lesion	Lateral ventricles	Third ventricle	Localizing value
27 U34948	Left parietal extending into body of ventricle	Hæmangioblastoma	Filling defect of body of left lateral. Both dislocated to right	Dislocated to right	Positive Localizing
28 U23127	Right frontoparietal	Spongioblastoma multiforme	Right anterior horn and body not visualized. Both displaced to left	Dislocated to left	Positive Localizing
29 U20037	Right parietal	Astrocytoma	Right anterior horn not seen. Right body shows pressure deformity. Both ventricles displaced to left	Dislocated to left	Positive Localizing
30 U18832	Right parietal	Huge cyst. Sections of wall show only gliosis	Deformity of body of right. Both displaced to left	Dislocated to left	Positive Localizing
31 U37266	Right cerebral	Subdural hæmatoma covering hemisphere	Right lateral not seen in 2 P.A. views, but visualized in a third	Not visualized	Indeterminate
32 U18281	Left parietal	Small astroblastoma between body and inferior horn	Normal	Normal	Misleading
33 U36119	Right parietal	Spongioblastoma multiforme	Pressure deformity of roof of right body. No dislocation	Normal	Positive Localizing
34 S17828	Right parietal	Astrocytoma	Deformity of right anterior horn and body. No dislocation	Normal	Positive Localizing
35 U14458	Right occipitoparietal	Spongioblastoma multiforme	Body and posterior horn of right depressed	Normal	Positive Localizing
36 S1786	Right parietal	Sarcoma	Collapse of right. Left displaced to left	Dislocated to left	Positive Lateralizing
37 U38921	Left frontoparietal	Meningeal fibroblastoma	Collapse of body of left and pressure deformity of body of right. Right displaced to right	Dislocated to right	Positive Localizing
38 B280	Left parietal	Spongioblastoma multiforme	Collapse of body of left with pressure deformity of its posterior portion	Normal	Positive Localizing

table equipped with a Potter-Bucky diaphragm was employed. The table top with a fixed tube arm was rotated 90 degrees and the exposures made with the tube underneath and the film above the head in order to bring the air filled portions of the ventricles as close as possible to the film. The series always included anteroposterior and postero-anterior views and right and left lateral stereoscopic views. In many recent cases there were special exposures such as that employed by Balado, Morea, and Donovan (3) for visualization of the third ventricle or the horizontal exposure used by Naffziger (13).

RESULTS

Ninety-seven cases were studied. Of these 26 were frontal lobe lesions, 12 parietal, 16 temporal, 5 suprasellar, 12 in the pineal region, and 26 lay in the posterior fossa (Table I). Such localizations, of course, are not strictly accurate, since large tumors in any of the lobes of the cerebral hemispheres are likely to extend into or impinge upon portions of adjacent lobes. Thus, although none of the tumors in this series of cases is classified as "occipital," several of the "parietal" and "temporal" tumors involved the occipital lobes as well.

In each case, the region specified herein is that in which the greater portion of the lesion was located. The cases are classified as "positive," "indeterminate," or "misleading" on the basis of interpretation of ventriculograms alone, without consideration of clinical findings. By "positive," it is meant that the approximate location of the lesion could be definitely determined from examination of the films alone. The "positive" cases in the cerebral hemispheres are further subdivided into "lateralizing" and "localizing" groups, according to whether the hemisphere or the particular lobe involved could be determined. The classification "indeterminate" is applied to those cases in which the findings were abnormal, but the location was not definitely indicated. Under "misleading" are placed those cases in which the ventriculographic findings indicated an incorrect location of the lesion or in which normal ventricular outlines were found, even though a space occupying lesion was subsequently proved to exist.

The various cases will be considered in groups,

TABLE IV.—TEMPORAL LESIONS

Case	Site	Lesion	Lateral ventricles	Third ventricle	Localizing value
39 U34944	Left occipito	Sarcoma	Pressure deformities of left inferior and posterior horns. Both ventricles displaced to right	Dislocated to right	Positive Localizing
40 I2425	Left frontotemporal	Huge arachnoid cyst	Left inferior horn not visualized. Both ventricles displaced to right	Dislocated to right	Positive Localizing
41 S17506	Left temporal	Spongioblastoma multiforme	Both dislocated to right. Incompletely filled in lateral views	Not visualized	Positive Lateralizing
42 U35278	Right occipito	Spongioblastoma multiforme	Both dilated. Both displaced to left, incompletely filled	Dislocated to left	Positive Lateralizing
43 U10460	Left temporal	Spongioblastoma multiforme	Left inferior horn not visualized. Right dilated. Both displaced to right	Dislocated to right	Positive Localizing
44 S17584	Right temporal	Astroblastoma	Right inferior horn not visualized. Both dislocated to left	Dislocated to left	Positive Localizing
45 U22451	Right parietotemporal	Astrocytoma	Both incompletely filled but dislocated to left	Dislocated to left	Positive Lateralizing
46 U10322	Right temporal	Astrocytoma	Partial collapse of right. Both dislocated to left	Dislocated to left	Positive Lateralizing
47 U31145	Right temporal	Meningeal fibroblastoma	Both dilated, left more than right. Both dislocated to left	Dislocated to left	Positive Lateralizing
48 U22809	Left temporal	Venous angioma on cortical surface	Normal	Normal	Misleading
49 U27865	Left temporal	Spongioblastoma multiforme	Both dislocated to right, incompletely filled	Dislocated to right	Positive Lateralizing
50 U25295	Right temporal	Spongioblastoma multiforme	Right not visualized. Left dilated and dislocated to left	Dislocated to left	Positive Lateralizing
51 U27019	Left temporal	Metastatic carcinoma	Left partially collapsed. Both dislocated to right	Dislocated to right	Positive Lateralizing
52 I441	Left temporal	Ganglioneuroma	Left dislocated to right. Right dilated	Not visualized	Positive Lateralizing
53 U34916	Left frontotemporal	Ependymoma	Left not visualized. Right incompletely filled and displaced to right	Dislocated to right	Positive Lateralizing
54 G2514	Left temporal	Subdural hæmatoma	Normal	Normal	Misleading

TABLE V.—SUPRASELLAR LESIONS

Case	Suprasellar calcification	Lesion	Lateral ventricles	Third ventricle	Localizing value
55 U30549	Present	Craniopharyngeal pouch cyst	Both slightly dilated	Not visualized	Positive
56 S1669	Absent	Craniopharyngeal pouch cyst	Both dilated	Very faintly visualized. Not dilated	Indeterminate
57 U35780	Present	Craniopharyngeal pouch cyst, largely left sided	Both dislocated to right. Deformities of left temporal and right anterior horns	Dislocated to right	Positive
58 U28875	Absent	Meningeal fibroblastoma	Deformity of floor of left anterior horn	Normal	Positive
59 U38881	Absent	Meningeal fibroblastoma	Deformities of inferior, medial borders of both anterior horns	Dislocated posteriorly with deformity of anterior border	Positive

according to the location of the lesion.

1. *Frontal.* In this group of 26 cases, 22 are classified as positive, 3 as indeterminate, and 1 as misleading (Tables I and II). In the single misleading case, normal ventricular relationships were found in a patient from whose left frontal lobe there was subsequently removed a small organized aneurysm. This measured less than 2

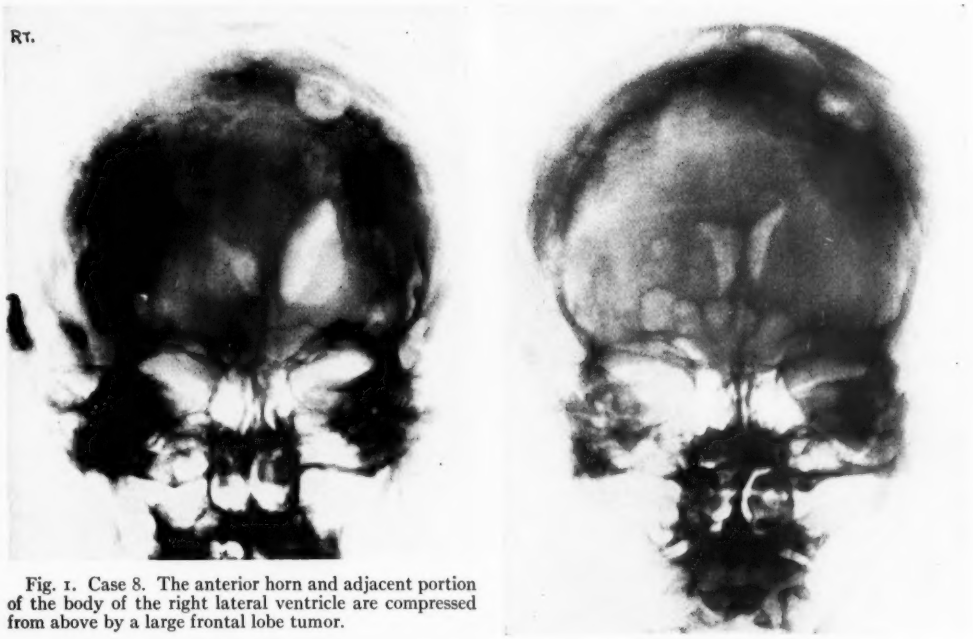

Fig. 1. Case 8. The anterior horn and adjacent portion of the body of the right lateral ventricle are compressed from above by a large frontal lobe tumor.

centimeters in its greatest dimension and lay very close to the cortical surface. In this location it would not be expected to cause a ventricular deformity. Of the 22 positive cases, the exact location could be determined in 16 and the hemisphere involved in the 6 remaining cases. Contralateral dislocation of the lateral and third ventricles was found in 16 cases and localizing deformities or dislocations in 16 cases. In one instance (Case 13) the outline of an intraventricular tumor was brought into relief by the air.

2. Parietal. Of the 12 cases in this location (Table III), 9 showed localizing abnormalities, 1 could be only lateralized, 1 was indeterminate, and 1 misleading. In 6 cases there was dislocation of the ventricular system to the side opposite the lesion and in 9 the locations were indicated by localizing deformities.

3. Temporal. Of the 16 cases with temporal lobe lesions, the ventriculograms of 14 were positive (Table IV). However, only 4 of these showed localizing abnormalities, the remaining 10 indicating only the side of the lesion. The 2 additional cases were misleading, both showing normal ventricular outlines in the presence of superficial, extracortical, "flat" lesions, in one instance (Case 48) a venous angioma, in the other (Case 54) a subdural hæmatoma. All 14 of the positive cases showed dislocation of the ventricular system. (In 2 of them the third ventricle was not visualized.)

Fig. 2. Case 33. The body of the right lateral ventricle is deformed by a spongioblastoma multiforme of the right parietal region. The third ventricle is slightly displaced to the left.

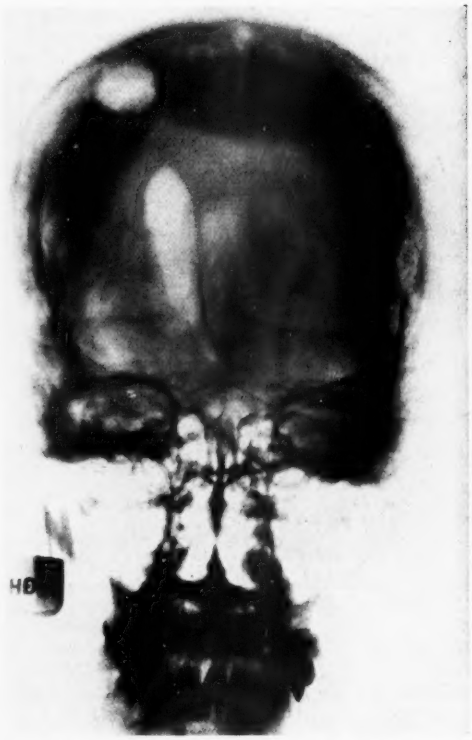

Fig. 3. Case 43. The ventricular system is displaced to the right, and the left inferior horn is collapsed by a large left temporal lobe tumor. The right lateral ventricle is dilated.

4. Suprasellar. In 3 of the suprasellar cases (Table V) definite localizing deformities were present. A fourth is classified as positive on account of the presence of dilated lateral ventricles, obliterated third ventricle, and suprasellar calcification. A fifth case (Case 56) showed dilated lateral ventricles, a small, very faint third ventricle, but no calcification. It is listed as indeterminate.

5. Pineal region. In this category are included all lesions arising primarily in or near the midline immediately above the tentorium (Table VI). Of the 12 cases, 9 were positive, 2 misleading, and 1 indeterminate. In the two misleading cases, the third ventricle, as well as both lateral ventricles was dilated but without deformity. In the indeterminate case only one of the lateral ventricles was visualized. Localizing deformities were present in 3 cases, in one of which (Case 64) the tumor shadow was visualized.

6. Posterior fossa. Twenty of the 26 cases in this group were positive (Table VII), 4 are listed as misleading on account of failure to visualize the third ventricle and 1 because the entire series showed normal relationships (in a patient having a superficial plaque of metastatic carcinoma on the surface of one cerebellar hemisphere). The single remaining case was indeterminate because the third ventricle, though visualized, was not apparently dilated.

COMMENTS

Of the 97 ventriculograms reported only 18 failed to indicate the approximate location of the lesion. From the maze of possible anatomical deformities there are relatively few constant findings of diagnostic importance. In those cases with lesions in the cerebral hemispheres, dislocation of the ventricular system, including the third ventricle, to the opposite side is the most reliable

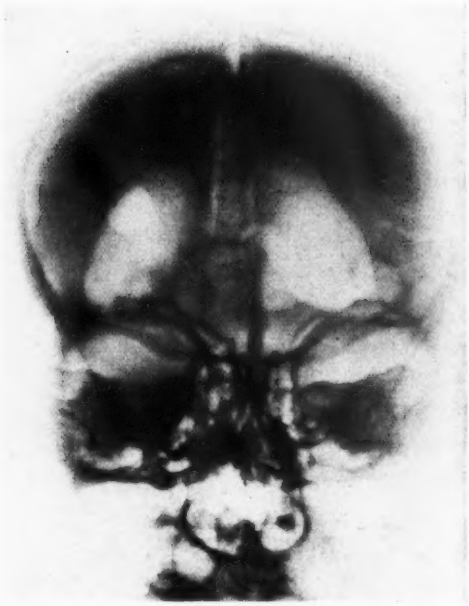

Fig. 4. Case 87. There is dilatation of the third and both lateral ventricles. This was produced by an astrocytoma obliterating the fourth ventricle. The cavum pellucidi is visualized.

and valuable finding. Filling defects may be deceptive and are of greater significance when associated with ventricular displacement.

Deformities of the anterior horns or their displacement in a vertical plane are often of great value, but must be interpreted with caution. In this series the most common localizing deformities caused by frontal lobe lesions were collapse or posterior displacement of the tip of the anterior horn (Fig. 1). It is for this reason that during the past year we have taken lateral views of the two anterior horns filled with air as recommended by Naffziger.

Parietal lobe lesions usually show displacement of the lateral ventricles and collapse or deformity of the body of the ventricle on the side of the lesion (Fig. 2), whereas temporal lobe tumors almost invariably (14 cases out of 16) cause dislocation of the lateral ventricle and the third ventricle with no dependable localizing deformity. Accompanying the dislocation there is usually some flattening of the body of the homolateral ventricle. Failure to visualize the entire inferior horn is a common result of incomplete filling of the ventricular system with air and cannot be regarded as of localizing significance unless it is persistently unilateral or accompanied by definite pressure deformity (Fig. 3). Even under these circumstances, it is often a deceptive finding and must be evaluated with great caution.

The posterior horns of the lateral ventricles have such a wide normal anatomical variation that in most cases no significance can be attached to apparent abnormalities observed in them. We have been unable to confirm the observation of

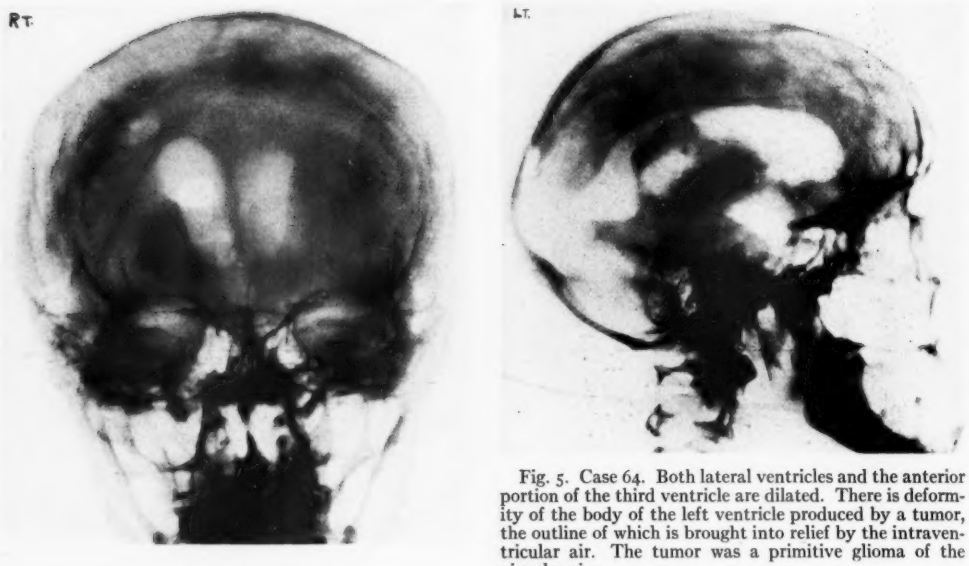

Fig. 5. Case 64. Both lateral ventricles and the anterior portion of the third ventricle are dilated. There is deformity of the body of the left ventricle produced by a tumor, the outline of which is brought into relief by the intraventricular air. The tumor was a primitive glioma of the pineal region.

TABLE VI.—PINEAL REGION

Case	Site	Lesion	Lateral ventricles	Third ventricle	Localizing value
60 F1647	Pineal	Pinealoma	Both dilated. No deformity	Not visualized	Positive
61 I323	Posterior to pineal recess	Arachnoid cyst	Both dilated. No deformity	Not visualized	Positive
62 U18781	Posterior portion of third ventricle	Spongioblastoma polare	Both dilated. No deformity	Not visualized	Positive
63 U34433	From posterior third ventricle forward	Astroblastoma	Both dilated. Right anterior horn slightly dislocated to left	Not visualized	Positive
64 U36603	Entire midbrain. Huge tumor, larger on left	Neuroepithelioma	Both dilated. Body of right upward. Tumor visualized	Dilated, dislocated to right. Pressure deformity of posterior border	Positive
65 U5297	Pineal	Arachnoid cyst	Both dilated. Pressure deformity of posterior, inferior, medial walls	Pressure deformity of posterior border	Positive
66 U22691	Pineal	Cholesteatoma	Both dilated. No deformity	Not visualized	Positive
67 S11481	Posterior portion of third ventricle	Astroblastoma	Both dilated. No deformity	Not visualized	Positive
68 G2175	Pineal	Spongioblastoma multiforme	Slightly dilated	Slightly dilated	Misleading
69 F2036	Pineal	Pinealoma	Only right lateral visualized and dilated	Not visualized	Indeterminate
70 U17990	Pineal	Pinealoma	Both dilated. No deformity	Dilated. No deformity	Misleading
71 U31405	Pineal	Pinealoma	Both dilated. No deformity	Tiny spot of air. Not dilated	Positive

Fig. 6. Case 55. The third ventricle is obliterated by a suprasellar cyst. Flocculent suprasellar calcification is seen (arrows).

Elsberg and Silbert that unilateral lesions in the posterior fossa cause corresponding deformity or displacement of the overlying posterior horns. However, outward and upward displacement with deformity of the inferior surfaces of the posterior horns does occur with large tumors in the pineal region (Fig. 4). Such abnormalities usually involve the bodies of the ventricles as well as the posterior horns. In suspected unilateral occipital lobe lesions, anteroposterior and lateral views with the occiput uppermost are of great value. Displacement is of greater significance than variation in size or shape.

In the absence of definite localizing abnormalities, the exact location of cerebral lesions cannot be determined by ventriculography alone. However, three additional facts brought out by this study are of some significance and, when correlated with clinical evidence, may be of great value. First, temporal lobe lesions cause contralateral dislocation of the system in a much higher proportion of cases (Table I) than do lesions elsewhere in the hemisphere (doubtless due to their position lateral to, rather than above the ventricular system). Second, parietal and, to a slightly lesser extent, frontal lobe lesions cause localizing deformities much more frequently than do lesions in the temporal lobe. Third, failure to visualize the ventricle on the side of the lesion (probably due to obstruction of the foramen of Munro) occurs much more frequently with frontal lesions than with those elsewhere: 6 of 26 (23 per cent) frontal cases as opposed to 1 of 12 (8 per cent) parietal and 2 of 16 (12 per cent) temporal cases.

The classical ventriculographic picture of posterior fossa lesions is uniform, symmetrical dilatation of both lateral ventricles and of the third ventricle. This picture is borne out by most of the cases in this study. However, in 5 cases the third ventricle was not visualized. Such misleading findings may lead to the dangerous misconception that the lesion lies above the tentorium, with a resulting negative and often disastrous supratentorial exploration.

The converse difficulty is often encountered in patients with midline lesions lying immediately above the tentorium, tumors of the pineal region,

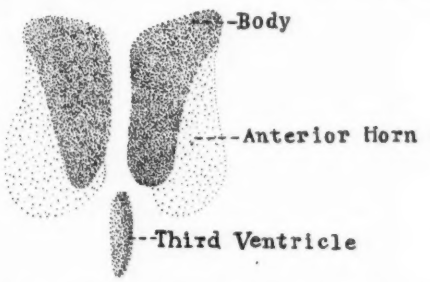

Fig. 7. Diagram of normal appearance of ventricles as seen in postero-anterior view.

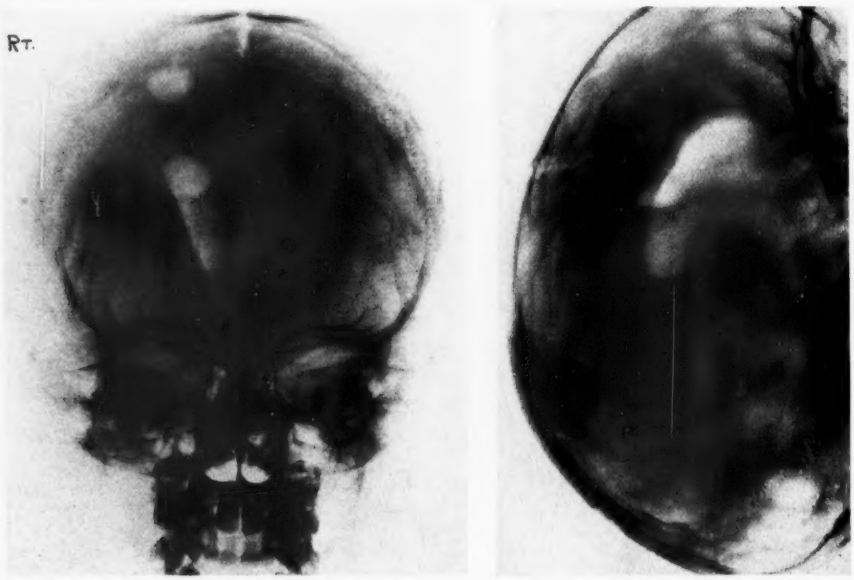

Fig. 8. There is visualization of part of the body and anterior horn of the right lateral ventricle. Note that the "butterfly wing" (body) of the left ventricle is absent in the postero-anterior view. Only the anterior horn of the left ventricle is visualized as may be seen in the lateral view. Both films made without changing the position of the head. (This is a recent case not included in the present series.)

the corpora quadrigemina, or the posterior portion of the third ventricle. Ventriculograms in patients with these lesions often show a uniform dilatation of the lateral ventricles and non-visualization of the third ventricle. However, in some cases the anterior portion of the third ventricle is dilated (Fig. 4). In all cases in which this question arises it is imperative to make every effort to determine which portion of the third ventricle is visualized. Of greatest value are lateral views with occiput and face dependent.

The importance of this difficulty is not universally recognized. Some authors seem to assume that the presence or absence of third ventricle visualization is proof that the lesion lies below or above the tentorium. Thus Grant in the legend of Figure 10 says, "Note that in subtentorial tumors, the third ventricle is clearly shown, whereas in supratentorial midline tumors, it is not clearly shown." Similarly, Adson states, "Lesions of the posterior fossa produce internal hydrocephalus, with dilatation of the lateral and third ventricles." In his series are 15 ventriculograms in patients with verified lesions. Of these only one lesion lay in the mid-brain (Case 130), and in this case the ventriculogram indicated "lesion of the posterior fossa" and led to a negative cerebellar exploration. In the present series, five infratentorial and two supratentorial cases are listed as misleading on account of failure to bear out these dicta. The difficulty of distinguishing these two groups of tumors on the basis of clinical findings has been repeatedly pointed out (11, 12). From the data presented in this paper, it seems that the solution is not to be found in all cases by means of ventriculography. This fact has also been pointed out by Bailey. Dandy, recognizing the difficulty, thinks it can usually be overcome by one's ability or failure to demonstrate the suprapineal recess in the third ventricle. This finding has not proved sufficiently dependable in this clinic to warrant a similar conclusion. Dandy also points out the fact that some pineal tumors produce pressure deformities of the posterior portion of the third ventricle. The group of cases presenting the greatest difficulty, of course, is that in which the lesion, primarily below the tentorium, has extended upward to cause both clinical and ventriculographic findings simulating a supratentorial lesion.

It is sometimes stated that suprasellar lesions obliterate (10) or deform (1) the third ventricle

TABLE VII.—POSTERIOR FOSSA

Case	Site	Lesion	Lateral ventricles	Third ventricle	Localizing value
72 S12091	Cerebellum	Abscess	Both dilated	Dilated	Positive
73 U13118	Vermis cerebelli	Ependymoma	Both dilated	Not visualized	Misleading
74 G443	Fourth ventricle	Papilloma	Both dilated	Dilated	Positive
75 U3711	Fourth ventricle	Papilloma	Both dilated	Dilated	Positive
76 U24908	Pons	Medulloepithelioma	Both dilated	Dilated	Positive
77 U28226	Left eighth nerve	Perineural fibroblastoma	Both dilated	Dilated	Positive
78 D470	Cerebellum	Spongioblastoma* multiforme	Both dilated	Dilated	Positive
79 U14668	Fourth ventricle	Papilloma	Both dilated	Dilated	Positive
80 D1681	Vermis cerebelli	Medulloblastoma	Both dilated	Very faint but dilated	Positive
81 U25346	Cerebellum	Hæmangioblastoma	Both dilated	Not visualized	Misleading
82 I536	Pons	Astrocytoma	Both dilated	Dilated	Positive
83 I2025	Fourth ventricle	Medulloblastoma	Both dilated	Dilated	Positive
84 U21929	Left cerebellum	Sarcoma? medulloblastoma	Both dilated	Dilated	Positive
85 U9308	Left cerebellopontile angle	Meningeal fibroblastoma	Both dilated. Right distorted (old decompression)	Dilated	Positive
86 U4445	Cerebellum	Tuberculoma	Both dilated	Not visualized	Misleading
87 U37495	Left cerebellum	Astrocytoma	Both dilated	Dilated 5th ventricle visualized	Positive
88 U13837	Cerebellum	Metastatic carcinoma	Normal	Normal	Misleading
89 U17093	Left eighth nerve	Perineural fibroblastoma	Both dilated	Slightly dilated	Positive
90 U22419	Vermis cerebelli	Astrocytoma	Both dilated. Peculiar bulging of roofs of both	Slightly dilated	Positive
91 U22806	Right cerebellum	Medulloblastoma	Both dilated	Dilated	Positive
92 U23935	Vermis cerebelli	Spongioblastoma polare	Both dilated	Dilated	Positive
93 U27340	Fourth ventricle	Papilloma	Both dilated	Dilated	Positive
94 U15303	Cerebellar	Hæmangioma	Both dilated	Dilated	Positive
95 U8436	Right cerebellar	Hæmangioblastoma	Both dilated	Visualized but not apparently dilated	Indeterminate
96 C326	Pons	Spongioblastoma polare	Both dilated	Dilated	Positive
97 E1019	Vermis cerebelli	Astrocytoma	Both dilated	Very faint but dilated	Positive

*See footnote, Table II.

Such changes occurred in 3 (Table V) of the 5 cases in this series (Fig. 6). The variation in the findings in our suprasellar cases is readily understood when one considers the variations in size, shape, and direction of growth which these lesions exhibit.

In rare instances, air in the ventricles brings into relief the positive shadow of a tumor not visualized on plain films. Such instances are Case 64, Table VI; and Case 13, Table II (Fig. 4).

One common fallacy in the interpretation of ventriculograms we should like to point out: It is sometimes considered (8) that the darker, sharply outlined, triangular "butterfly wings" seen in anteroposterior (or postero-anterior) exposures with the face uppermost are the tips of the anterior horns, but this is not the case. The "butterfly wings" are the anterior portions of the bodies of the ventricles and the tips of the anterior horns are visualized as the fainter, rounded shadows which are well separated (Fig. 7). It will be recalled that the anterior horns flare sharply laterally anterior to the foramina of Munro, whereas the bodies are, for the most part, separated only by the septum pellucidum. The relationship is clearly demonstrated in the two roentgenograms shown in Figure 8.

Dandy states that every space occupying lesion can be localized by means of ventriculography. But in the present series are 5 cases with verified lesions in which ventriculograms interpreted as normal were obtained (Cases 11, 32, 48, 54, and 88). The lesions in 3 of these cases were on the surface of the cortex and in the 2 others were quite small. Normal ventriculograms (at least according to the interpretation in this clinic) are suggestive, but by no means positive, evidence of the absence of a space occupying lesion.

It cannot be emphasized too strongly that pneumoventriculography is only an adjunct to neurological diagnosis though as such it may prove of inestimable value. However, as in the use of all contrast media, incomplete filling of or failure to visualize a cavity should not be interpreted as infallible evidence of a pathological state. As has been pointed out there are relatively few definite localizing criteria and these are closely dependent upon the size, shape, and position of the lesion. No arbitrary table of ventriculographic signs can be made, but rather does each individual problem demand every available technical and intellectual effort for its solution.

It is a pleasure to express our gratitude to Dr. Ernest Sachs and Dr. Sherwood Moore for their permission to report the material contained herein and for their valuable help and suggestions.

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UNILATERAL DISLOCATIONS OF CERVICAL VERTEBRÆ WITHOUT ASSOCIATED FRACTURE[1]

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UNILATERAL forward dislocations of the cervical vertebræ, complete or incomplete, without associated fractures, form a group of cases which because of the apparent ease with which the condition is acquired by the patient and the difficulty with which it is diagnosed by the doctor have seemed worthy of study. During the period from January 1, 1929, to July 1, 1933, 27 such patients have presented themselves to the Fracture Clinic of the Presbyterian Hospital and this paper is based on a study of this series of cases.

HISTORICAL SKETCH

The condition apparently has been known since Hippocrates but no detailed descriptions are found until the last half of the eighteenth century, according to Malgaigne, when Desault recognized the condition in the living and Preis in 1789 proved the possibility of such a dislocation on the cadaver. Seiffert in 1831 reported 3 cases; Schuk in 1841 and others published reports of single instances. Malgaigne in 1855 gives a summary of the knowledge of this condition up to that time and cites 3 cases of his own and 14 he had collected in which the patient survived. He states that Newman in 1814 was able to reduce a cervical dislocation by manipulation but he was not sure whether Desault had been able to reduce one earlier. Since 1855 various cases have been reported both in Europe and this country, most of them, however, dealing with more serious conditions than those described in this article. Langworthy in 1930 published a report of 13 cases of unilateral dislocation all without fracture, which is the largest single series we have been able to find.

This is, therefore, not the presentation of a new pathological lesion or a novel method of treatment. The aim is merely to give a composite picture of 27 cases, the methods of diagnosis, and the treatment which has been used with its results over a relatively short period of time.

CLINICAL PICTURE

The patient walks into the Clinic or Emergency Ward complaining that he has twisted his head and cannot straighten it or that he awoke and found his neck crooked. Pain is present but is apt to be a secondary symptom. The onset is acute in most instances and follows mild trauma—a jerk of the head to see a ball in the air, a sudden turn to answer a call, a bump in a car on a rough road, a twist of the head while dressing. Two dislocations in the present series occurred when the patient yawned. Inability to straighten his head accompanied by pain causes the patient to seek help usually within a few hours of injury. In this series 20 minutes was the shortest time which elapsed and 5 days the longest between onset and admission to the Clinic.

It may be of passing interest to note that of the 27 patients 18 were males. All of the series were under 40 years of age—15 between 10 and 20 years of age, and 8 between 20 and 30 years of age. The youngest patient was 6 and the oldest 38 years of age.

The picture these patients present when they apply for treatment is strikingly uniform. The head is held tilted and turned and the patient is obviously loath to change the position. If the articular facet is riding forward but has not slipped off, in other words if the dislocation is partial, the head is apt to be tilted and turned to one side, that away from the lesion (Figs. 1 and 2). If, on the other hand, the articular facet has slipped completely off and lies in the intervertebral notch the head is more apt to be tilted to the side of the lesion but turned away from it (Fig. 3). However, these findings are not constant in our series and authorities differ.

On further examination it is found that the patient is able to bend and turn his head further away from the injured side but all attempts to turn toward it are painful and resisted. When the patient tilts his head to the unaffected side the cervical spine curves in a gentle arc, but when he attempts to bend to the opposite side the body moves as a whole, the cervical spine remaining straight (Fig. 4). This is also demonstrated when the operator performs the motions passively. Flexion and extension of the neck are usually not much affected. When there is spasm of the muscles it is always on the side of the lesion regardless of the position of the head, which is an important sign in differentiating the incomplete lesion from torticollis. Tenderness is also demonstrable in almost every instance at the site of the lesion. In some cases deviation of the spinous processes can be made out but in the milder forms this is very

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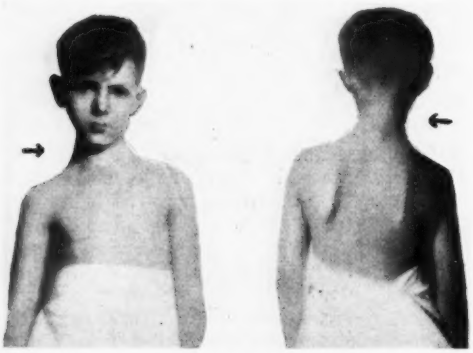

Fig. 1. Photographs showing the characteristic pose of the head. The spasm of the sternocleidomastoid on the long side of the neck is noticeable. The arrows designate the side of the lesion.

seldom evident. There have been no symptoms suggestive of cord or nerve root lesions in this series of cases.

Given then a patient complaining of a twisted, painful neck following an inconsiderable trauma and showing the head turned and tilted to one side with tenderness and muscle spasm on the opposite side of the neck, the examiner is justified in making a tentative diagnosis of partial unilateral dislocation of a cervical vertebra pending the roentgenographic examination. Should the roentgenographic examination prove to be negative the examiner is still justified in assuming that a partial dislocation has occurred and has been spontaneously reduced leaving residual muscle spasm and soreness.

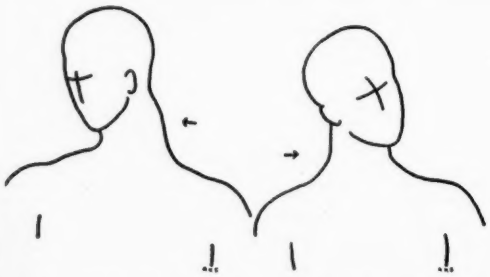

Fig. 2, left. Drawing showing the tilt and rotation of the head in an incomplete unilateral dislocation. The arrow designates the side of the lesion.

Fig. 3. Drawing showing the tilt and rotation of the head in a complete unilateral dislocation. The arrow designates the side of the lesion.

X-RAY EXAMINATION

While the roentgenogram is not an absolutely essential diagnostic procedure, it has clinched the diagnosis in 26 of the 27 cases in our series. Certainly we must disagree with the rather broad statement made by Langworthy in 1929 that "the lesion cannot be shown by roentgenograms." Technically good films studied with care will, we think, reveal the point of dislocation in the majority of cases where otherwise it would be easily overlooked. Perhaps the only reason that all the dislocations are not recognized roentgenographically is due to the fact that there has been a subluxation of such minor degree that as mentioned above it may reduce spontaneously or with as little manipulation as is used in placing the patient for roentgenography.

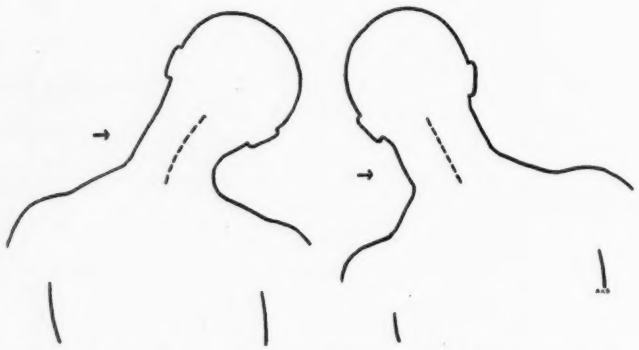

Fig. 4. Drawing showing the curve of the cervical spines when the head is inclined away from the affected side and the lack of curve when the head is inclined toward it. The arrows designate the side of the lesion.

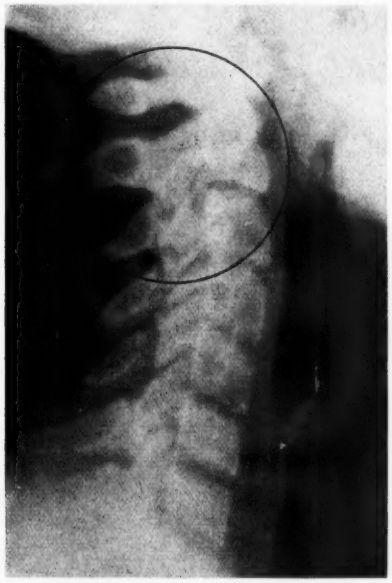

Fig. 5. Lateral film of a case of subluxation of the articular facet of the second segment on that of the third. A projection has been added (lower right) to enable us to outline the facet surfaces. The dotted lines show the normal facets. The heavy tracings show the surfaces where the dislocation exists.

Our routine films include a stereoscopic lateral projection of each side, a stereoscopic anteroposterior film at two different levels to allow for the tilt of the chin, as well as a special projection through the open mouth in order better to study the upper two cervical segments and the odontoid process. Occasionally a fracture without displacement may be found in this process, a fact which is of obvious importance.

Stereoscopic films are *essential* if minute deviations from the normal are to be recognized, and we therefore realize the difficulty and the relative futility of reproducing prints of flat films. We have therefore included a diagrammatic sketch with each print more clearly to depict the level of the lesion (Figs. 5 to 17, inclusive). These show one facet surface moved upward and forward on that of the one below. Sometimes a slight backward displacement of the corresponding facet on the opposite side can be recognized. This abnormal relationship of the facets may be the only recognizable finding. When there is associated with the unilateral subluxation a fracture of any of the component parts of the vertebræ or a dislocation

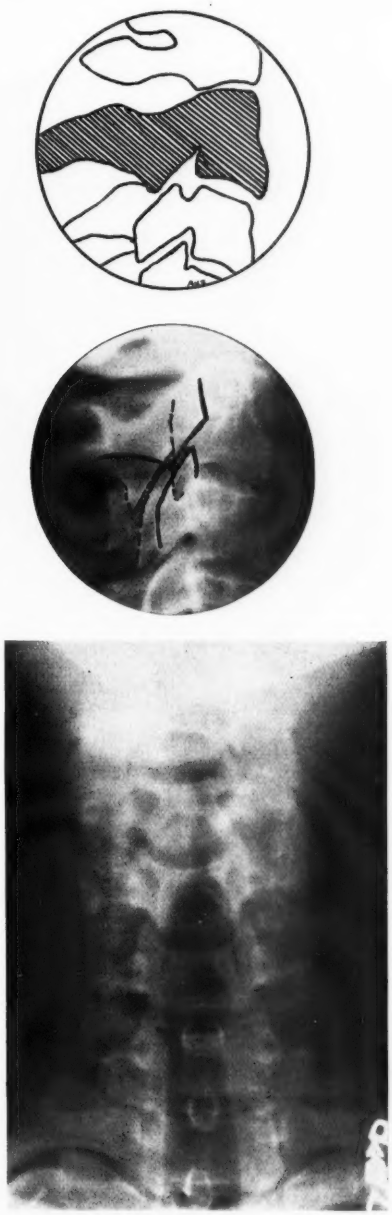

Fig. 6. Anteroposterior projection of the same case as in Figure 5. The level of dislocation is unfortunately obscured by the characteristic tilt of the chin.

Fig. 7. Same case as in Figures 5 and 6—postreduction showing a normal relationship of the facets.

Fig. 8. Same case as in preceding films—postreduction anteroposterior film.

of the body of the segment the diagnosis is of course most obvious.

The objection may be raised that apparent dislocations may be seen and falsely "read into the films" because the films are not perfect lateral projections. This is certainly a difficulty to be kept in mind but even in somewhat oblique lateral

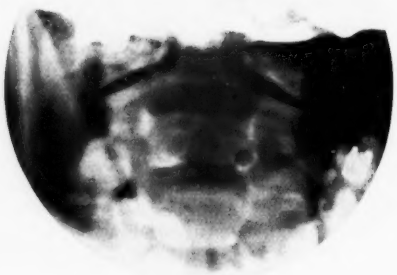

Fig. 9. A representative anteroposterior projection taken with the mouth open so as to eliminate the superimposed mandible shadow and show the odontoid process.

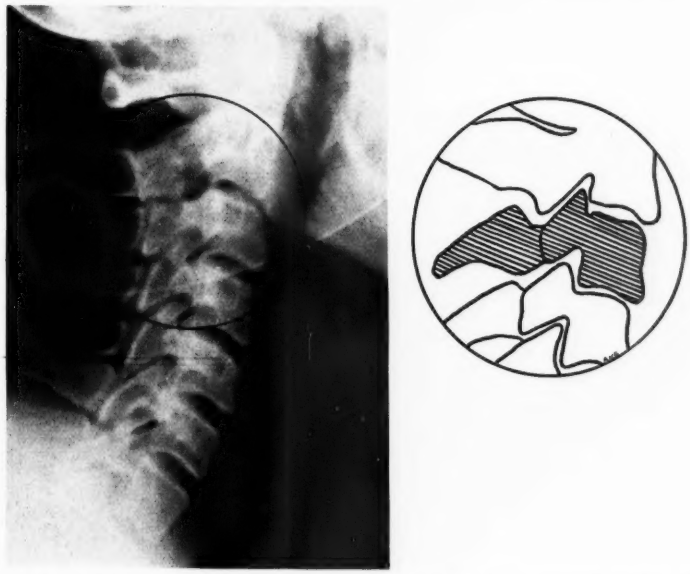

Fig. 10. Lateral film showing dislocation of facet of the third segment on that of the fourth.

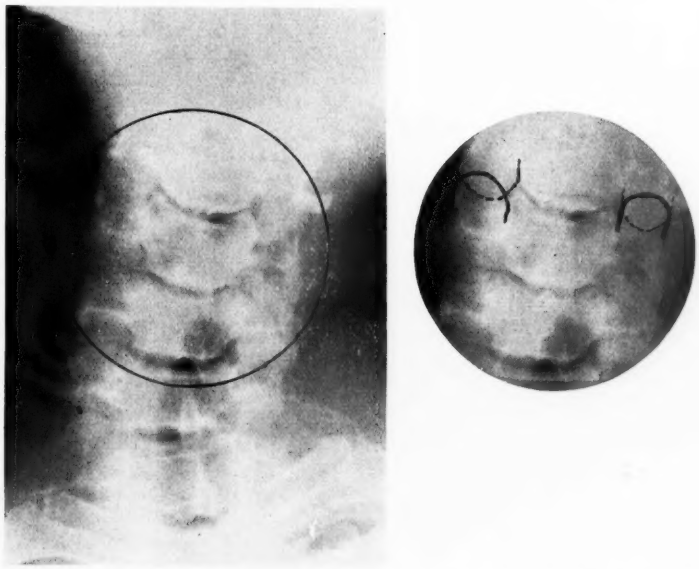

Fig. 11. Anteroposterior projection in same case as in Figure 10. Note the larger superimposed facet shadow on the side of the partial dislocation.

Fig. 12. Same case as in Figure 10—latera film (postreduction).

Fig. 13. Same case as in Figure 10—anteroposterior film (postreduction).

films the facet surfaces will not appear displaced upward and forward if one takes their anterior edges as an index or if the position of the posterior edge of the upper facet is compared with the anterior edge of the lower (Fig. 18). The position of the facets at the other levels at the same time appear equal. This will be the deciding factor. If, in the lateral films, the posterior edges are used as an index, then we agree that the roentgen evidence is not reliable. The anteroposterior projections also are most useful in preventing incorrect interpretations, as in true subluxations they show a longer superimposed facet shadow on the involved side with a slight tilt of the spine to the opposite side at that level.

Our series of 27 cases reported here are all of the incomplete variety, the dislocated facet having in no case slipped completely forward into the intervertebral notch. In only 1 case did the X-ray fail to show the lesion. In this particular case the examination was incomplete. The second segment was involved nine times, the third segment seven times, and the fourth and fifth segments five times each. One case as stated remains inconclusive.

The clinical interpretation as to the level of the lesion has shown a striking agreement with the X-ray findings in all cases, the roentgenograms having been originally studied without knowledge

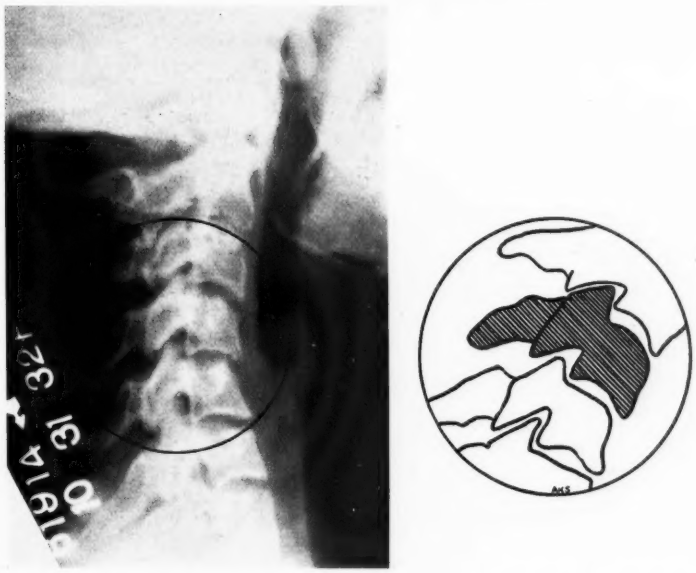

Fig. 14. Lateral projection showing a forward subluxation of the fourth on the fifth segment with the third also displaced on the fourth to a lesser degree.

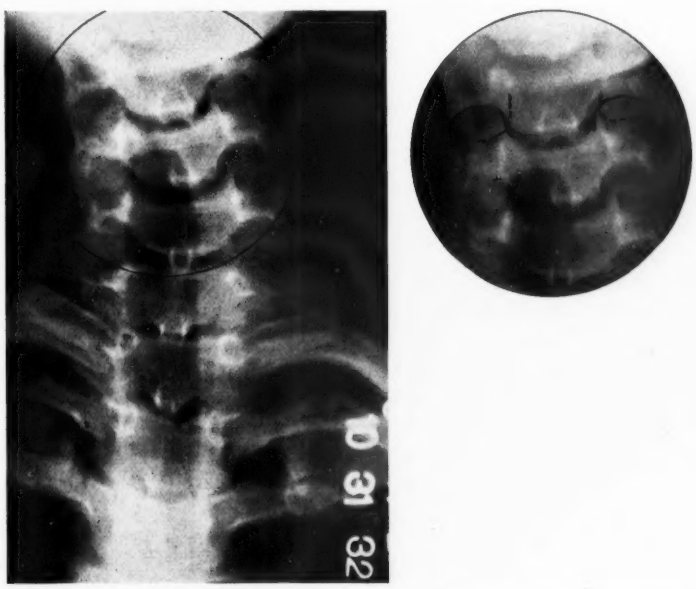

Fig. 15. Anteroposterior film of same patient as in Figure 14. Note the larger superimposed facet shadow on the side of the partial dislocation.

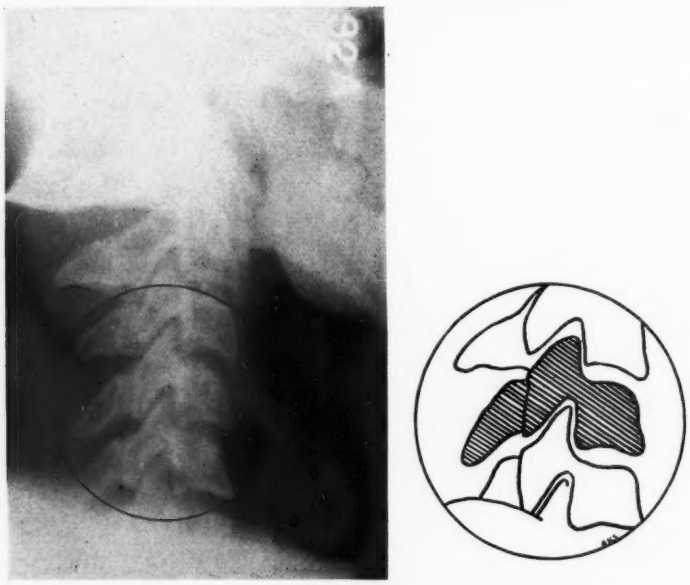

Fig. 16. Lateral film of patient shown in Figure 14 (postreduction).

of the clinical situation. This, we think, testifies to the fact that no false impressions have been developed as to the accuracy of the X-ray findings. If the roentgen examination has done no more than check the level of the supposed

Fig. 17. Anteroposterior projection of the same case as in Figure 14 (postreduction).

Fig. 18. Normal cervical spine (oblique projection) showing the anterior edges of the facets even, in spite of the distortion due to the oblique position. The opposing facet edges of the second and third segments have been heavily outlined.

TABLE I

Case	Manipulation	Traction		Plaster collar Duration	Leather collar Duration	Results
		Weight	Duration			
1		5 lbs.	48 hrs.			Patient lost
2		5 lbs.	1 wk.	7 days	3½ months	1 yr. full function
3	Without anæsthetic			9 days		5 wks. full function, lost
4		10 lbs.	18 hrs.	14 days		1 yr. full function
*5	Gas and oxygen immediately		6 days	7 days	2 mos., 3 wks.	10 mos. full function
6	Gas and oxygen p 36 hrs'. traction	10 lbs.	36 hrs.	14 days	8 weeks	2½ mos. full function
7		10 lbs.	48 hrs.	21 days	11 weeks	6½ mos. full function
8	Spontaneous reduction			(felt collar) 8 days		Patient lost
9		10 lbs.	24 hrs.	7 days	2½ months	18 mos. full function
10		15 lbs.	48 hrs.	14 days	11 wks., 5 days	13½ mos. full function
11			48 hrs.	17 days	8 weeks	8 mos. full function
12		10 lbs.	48 hrs.	21 days	10 weeks	27 wks. full function
13		10 lbs.	24 hrs.	22 days	12 weeks	15½ mos. full function, ache p exertion
14	Gas and oxygen p 17 hrs'. traction	10 lbs.	17 hrs.	24 days	15 weeks	6 mos. full function
15		10 lbs.	18 hrs.	16 days	(felt collar) 1 month	8 mos. full function
16		12 lbs.	18 hrs.	28 days		8 mos. full function
17		10 lbs.	20 hrs.	60 days		1 yr. full function
18		7 lbs.	48 hrs.	21 days	12 weeks	10 mos. full function
19			48 hrs.	13 days	10 weeks	10 wks. full function, lost
†20		10 lbs.	24 hrs.	28 days		Recurrence at 5½ mos.
21		8 lbs.	26 hrs.	42 days		6 mos. full function
22		10 lbs.	48 hrs.	(felt collar) 21 days		6 mos. full function
23		10 lbs.	24 hrs.	21 days	5 weeks	10 mos. full function
‡24	Gas and oxygen p 36 hrs.' traction	10 lbs.	36 hrs.	32 days		Recurrence at 7 wks.
25		7 lbs.	24 hrs.	20 days		3½ mos. full function
26		10 lbs.	2 hrs.		18 days	5 wks. pain over mandible, lost
27		10 lbs.	40 hrs.	32 days		2½ mos. full function

*Re-dislocated in plaster after 1 week, put in traction for 6 days, then plaster for 1 month, followed by leather.
†Recurrence after 5½ months.
‡Recurrence after 7 weeks.

lesion and has ruled out further fractures and dislocations it has served a real purpose. With films carefully made the percentage of error should not be high.

TREATMENT

When the diagnosis has been established, treatment should be at once instituted. Two methods are available—manipulation, preferably under a general anæsthetic, or traction by means of some form of head-piece. Occasionally reduction occurs spontaneously during some part of the examination or under the anæsthetic before any manipulation has been attempted. In the incomplete type head traction of about 10 pounds with the head of the bed on high shock blocks has been found to reduce the dislocation in a number of cases. In the present series 1 reduced spontaneously during the taking of X-rays, 1 was reduced by manipulation without anæsthetic, 4 were reduced by manipulation under nitrous oxide gas-oxygen, and the 21 remaining by head traction which was maintained usually from 18 to 48 hours. One case

Fig. 19. Drawing showing a method of traction by means of a swathe around the patient's chin and occiput and tied around the operator's waist.

was reduced in 2 hours of head traction, 10 pounds applied by a Crile head-piece.

The method of manipulation most frequently used is attributed to Walton who described it in 1892 and consists of "extending the head diagonally backward toward the side of the convexity of the neck," thereby elevating the articular process. A slight rotation then restores the normal position. It is interesting to find a very similar procedure described by Malgaigne—"Le procédé le plus simple consiste à appuyer les deux genoux sur les épaules du blessé, pour faire la contre-extension; à embrasser le menton avec les deux mains pour attirer la tête en haut d'abord, puis de côté opposé à la luxation; et l'apophyse ainsi dégagée, à la reporter à sa place par un mouvement de rotation." In the complete type considerable traction is needed and can be supplied by a muslin or flannel bandage around the patient's chin and occiput and tied around the operator's waist—thus leaving his hands free to manipulate the neck (Fig. 19). Countertraction from the shoulders to the foot of the table is essential.

That a satisfactory reduction has been accomplished by manipulation or by traction can be ascertained (1) by the absence of the pre-existing deformity, (2) by the freedom of motion of the neck, especially lateral bending, as previously described, (3) by follow-up roentgenograms which should always be obtained.

After reduction by either means a well fitting, carefully molded plaster collar is applied and kept on from 1 to 4 weeks (Fig. 20). In 14 cases the plaster collar was followed by a leather one which the patient wore from 8 to 16 weeks. The table summarizes the treatment used in the 27 cases under discussion. It is of some interest that in Cases 20 and 24, in which the patients wore plaster collars for 4 weeks but no protection thereafter, they returned, with a recurrence of symptoms, 1 after 5½ months and 1 after 7 weeks. Sixteen patients followed for 6 months or more after the conclusion of treatment report no further trouble. Six patients show satisfactory results at the end of 3 months. In the 5 remaining cases the patients were lost track of.

It is quite possible that not all cases need such extensive and prolonged protection but as yet we are not ready to give any criteria by which to judge the possibility of recurrence in any given case. Undoubtedly those patients who show little or no X-ray evidence of dislocation or in whom reduction has been spontaneous have undergone less damage to the soft parts and would therefore require a shorter period of treatment than those who have shown definite mal-alinement roent-

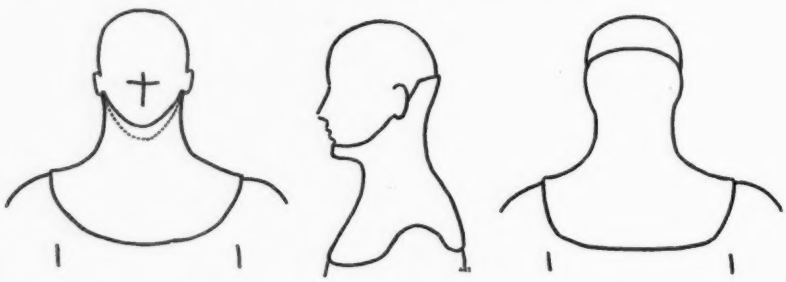

Fig. 20. Anterior, lateral, and posterior views of the type of plaster collar used.

genologically and who have required manipulation or continued traction. Further study of more cases over a longer period of time is necessary before definite conclusions on this point can be reached.

SUMMARY

A study of 27 cases of unilateral dislocation of the cervical vertebræ without fracture has been made and the clinical and X-ray picture presented in an attempt to emphasize the relative frequency and facility of occurrence and the ease of diagnosis.

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PREGNANCY AND PARTURITION FOLLOWING BILATERAL URETERAL TRANSPLANTATION FOR CONGENITAL EXSTROPHY OF THE BLADDER

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ONE hundred forty-five patients with congenital exstrophy of the bladder were seen in The Mayo Clinic in the 20 years between 1912 and 1932. Thirty-five of these, 24.1 per cent, were females. Twenty-eight of the 35 have undergone bilateral transplantation of the ureters into the sigmoid. Subsequently 5 of the 28 have married, and 4 of these have borne children. Three have been confined elsewhere, and 1 on our service. One patient has had three children, one has had twins, and two have had one child each. The histories of the 4 who have borne children have been reviewed, and the subsequent course of the patients brought up to date in our follow-up records.

REPORT OF CASES

CASE 1. The patient registered in October, 1913, when she was aged 30 years. Her family history was negative. The menses had commenced at the age of 12 years; the interval was 28 days; flow was 5 days in duration, and moderate in amount. General physical examination gave negative results. Roentgenograms of the pelvis gave evidence of wide separation of the pubic bones; the pelvis otherwise was apparently normal. Both ureters were transplanted into the sigmoid by means of an operation in two stages; and later the bladder was excised. At the time of the transplantation it was noted that the internal genitalia were normal. The subsequent course was uneventful, and the woman married 6 years later, in 1919. At the age of 38 years she had what was considered to be a miscarriage after gestation of 10 weeks. At the age of 41 years she conceived again, and pregnancy was uneventful aside from mild hyperemesis gravidarum in the early weeks. Approximately 6 weeks before term the membranes ruptured. She gave birth, elsewhere, spontaneously to twins; episiotomy was performed. Both children lived and presented no anomalies. For a few months following delivery the woman complained of pressure in the pelvis, and the cervix presented at the introitus. Since then, however, she has been well and is now 50 years of age.

CASE 2. The patient registered in 1917, when she was aged 22 years. Her family history and personal history were negative. Her menses had begun at the age of 19 years; the interval was 28 days; the duration of flow was 4 days, and there was moderate dysmenorrhœa at the onset. General physical examination gave negative results. Roentgenograms gave evidence of separation of the pubic bones. Bilateral transplantation of the ureters was done in separate stages, at which time it was noted that the internal genitalia were normal. Subsequently, the bladder was removed. Seven years later, elsewhere, the patient gave birth to a living child spontaneously and at term. Two years after this parturition she was delivered, also elsewhere, of a stillborn infant; the cause of the non-viability of the child was unknown. Both of the pregnancies and labors were essentially uneventful. Eight months following the last delivery she was seen at the clinic because of a complaint of prolapse. At that time, appendectomy, suspension of the uterus, and plastic closure of the anterior vaginal wall were effected. The woman again became pregnant 2 years after the abdominal operation, and gave birth at term, spontaneously; her subsequent course has been uneventful.

CASE 3. The patient was first seen in the clinic in 1911, when she was aged 2 years; the parents were advised to postpone treatment of the exstrophy of the bladder until the girl was somewhat older. She was brought to the clinic again in 1921, at the age of 12 years, and gave an essentially negative past history. The menses had begun at the age of 12 years, the interval was 28 days; flow was 5 days in duration, and moderate in amount. The ureters were transplanted into the sigmoid in two stages, at which time the internal genitalia were found to be normal. The patient returned 8 years later, when she was aged 20 years; at that time the bladder was removed and the introitus of the vagina was stretched under anæsthesia. She married following her return home and became pregnant at the age of 22 years. The course of the pregnancy was uneventful, and the woman was delivered, elsewhere, by cæsarean section, of a child weighing 5 pounds, 15 ounces (approximately 2.7 kilograms). The postpartum course was uneventful and the patient's health apparently has not been effected by the pregnancy.

CASE 4. The patient was first seen in the clinic in 1916 when she was aged 3 years. Two brothers had been born with congenital exstrophy of the bladder and both had died at the age of 5 months. Roentgenograms of the pelvis gave evidence of separation of the pubic bones. When the girl was aged 4 years, in 1917, the ureters were transplanted into the sigmoid in two separate operations. The patient re-entered the clinic when she was aged 15 years, in 1928, and at that time general physical examination gave negative results. She had begun to menstruate when she was between 12 and 13 years of age; the interval was 28 days; flow was of 3 to 4 days in duration and was moderate in amount. At the time of this second visit to the clinic the bladder was removed.

The patient entered the clinic again when she was 20 years of age, in the seventh month of her first pregnancy. Anal sphincteric control had been excellent at all times following transplantation of the ureters, and the patient had not noticed inconvenience in this regard during her pregnancy. She complained of a great deal of backache, was sensitive over both sacro-iliac joints, and had been unable to wear a girdle because of abdominal discomfort. General physical examination gave essentially negative results. The blood pressure was 130 millimeters of mercury systolic and 80 diastolic; examination of the eye grounds gave negative results; the value for urea was 24 milligrams per 100

cubic centimeters of blood, and the value for hæmoglobin was 75 per cent. The fetus was presenting by vertex, was deeply engaged in the pelvis, and the head was almost on the pelvic floor. The external pelvic measurements all exceeded the usual normal. The pubic bones were separated 6 centimeters. The sacral curve, as far as it could be palpated, was normal. The perineum was very long, because the vaginal introitus was directly between the two ends of the ununited pubic bones. The woman was kept under observation for 8 days, during which time the discomfort in the back persisted. No definite renal tenderness could be elicited, nor could evidence of hydronephrosis be discovered by palpation. On two occasions the temperature was 101 degrees F., without any obvious reason. It was felt that she probably had pyelitis.

Labor began spontaneously 8 days after the patient's admission, when gestation was approximately of 32 weeks' duration. The first stage of labor was uneventful and rapid; during this time the cervix and presenting part rested on the pelvic floor. Deep, left, mediolateral episiotomy was done, and a male child weighing 5 pounds and 10 ounces (2.5 kilograms) and 18 inches (46 centimeters) in length was delivered. Presentation was compound, a foot and the vertex appearing at the introitus. The total length of labor was 3 hours and 6 minutes. Following delivery of the child, the cervix and lower uterine segment prolapsed through the introitus; the incision of episiotomy was repaired, and an iodoform pack was placed in the vagina because of the prolapse. On the first day postpartum the temperature was 101 degrees F., and on the eighth day 101 degrees F. An intravenous urogram was made on the twelfth day, which gave evidence that the right and left renal pelves were normal, and the right and left ureters, dilated throughout. The subsequent course has been uneventful, except for moderate uterine prolapse, which is being observed by her physician at home.

Search of the literature (1 to 17) reveals that 28 children have been born to 20 women who had congenital exstrophy of the bladder, including the cases reported here. Five of the deliveries were by cæsarean section, and 1 patient underwent this operation twice. Vaginal delivery was accomplished in 23 cases. Fifteen of these were spontaneous with the vertex presenting. Three patients were delivered by instruments, 2 by version, and 2 by breech extraction. Record of the details of one confinement are unavailable. Seven children were stillborn and 21 were born alive. To the best of our knowledge there was no instance of the child having an anomaly similar to that of the mother.

The management of pregnancy of patients who are in the condition with which we are concerned has not received any special consideration. This probably arises from the fact that few such patients have lived sufficiently long to have children, and from the fact that most of them have not had the benefit of modern surgical care for the exstrophy; that is, transplantation of the ureters and subsequent cystectomy. As time goes on, however, more and more of these women probably will live to adult life and, with the hitherto hopeless deformity corrected, will marry. Genital anomalies apparently afflict a very small percentage of these patients; hence, their reproductive capacities are interfered with but little. It would seem essential that renal function be normal and evidence of renal infection be absent if these women are to attempt to become pregnant. Excretory urography will help to determine the condition of the kidneys and of the ureters. Close observation before delivery is obviously necessary. Urinalysis is impossible; hence, more dependence will have to be placed on readings of blood pressure and on estimations of increase in weight. Examination of the ocular fundi, estimation of the urea content of the blood, and determination of the values for serum proteins and serum sulphate will aid in following the condition through gestation.

The type of delivery for these patients would seem to hinge on the question of possible deleterious effect of vaginal delivery on the result of the operations for exstrophy of the bladder. It is difficult to see how the transplanted ureters could be injured in any way by labor, if they have tolerated the pregnancy. Hence, cæsarean section does not seem indicated solely because these patients have undergone previous ureteral transplantation and cystectomy.

The pelvic cavity is usually of justo-major proportions, with a defect of several centimeters in the anterior portion of the girdle, so that disproportion in the ordinary sense between the presenting part and the pelvis will not exist. Premature labor probably will occur in these cases more often than among patients whose pelves do not display this abnormality; it did occur in 2 of the 4 cases here reported. This fact, coupled with the large pelvis and small child may lead to compound presentation, as in Case 4, when a foot presented with the vertex.

The all-important point in relation to delivery through the vagina is preservation of the anal sphincter. The integrity of this muscle must be preserved for the comfort of the patient, and the good result from the ureteral transplantation is dependent entirely on the ability of the anal sphincter satisfactorily to hold urine in the bowel. Because of the fact that the perineum is extended ventrally, the vaginal introitus usually is between the ununited edges of the pubic bones. In the case in which we performed delivery, the pressure of the presenting part was directed low on the perineum, and because of the large pelvis there was interference with the usual mechanism of deflexion. Consequently, delay in the second stage of labor, with strong uterine contraction, might

lead to deep laceration of the perineum and possible injury to the anal sphincter. In addition because absence of the bladder brings the anterior wall of the vagina into closer relationship with the peritoneal cavity, these tissues should be protected. The second stage of labor is concerned with passage of the presenting part over the perineum, for the vertex or breech comes to rest on the perineum immediately the cervix is dilated. It would seem that the perineal stage of labor should be treated by early and sufficient mediolateral episiotomy. Because of the importance of the anal sphincter, median episiotomy should be avoided.

Prolapse of the uterus is a common postpartum complaint of these patients. In one of our cases, uterine suspension was necessary following two confinements. This patient has since borne a child without recurrence of the prolapse. The tendency to uterine prolapse may be used as an argument for cæsarean section in these cases.

The question of the number of pregnancies that these patients may undergo cannot be settled on the basis of present knowledge. The 7 deliveries at term of 4 patients have produced nothing more serious than uterine prolapse as a definite undesirable sequel.

It is of interest, in these 4 cases, that so far as we were able to determine, only 1 of the patients manifested evidence of urinary infection during pregnancy. Inability to examine the urine, of course, makes a definite diagnosis impossible. In 1 case, there seemed to be no certain explanation for the temperature of 101 degrees F. that was observed during the period before delivery.

The ability of any of the 4 patients to maintain sphincteric control, even during the latter part of pregnancy, apparently was not affected. The intravenous urograms taken on the twelfth and fourteenth days postpartum in Case 4 gave evidence of the same type of ureteral dilatation that is seen during pregnancy and in the early part of the puerperium of many gravid women. It is probable that this dilatation persisted longer in this case, and it raised the question of whether there may not be some permanent dilatation of the ureters. In Case 4 also, the patient complained of pain in the lumbosacral region and in the lumbosacral joints. We felt that this pain probably was related to the strain on the incomplete pelvic girdle. The compound presentation in Case 4 did not complicate delivery in any way. Three of the patients presented essentially justomajor pelves, and delivery was uneventful in each of these cases.

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CANCER OF THE VULVA

With a Report of One Hundred Eighteen Cases

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CANCER of the vulva is not rare. It is regarded as a very malignant disease, one in which recurrences after treatment are frequent, and if left untreated, it usually runs a rapidly fatal course; although occasionally exceptions may be observed.

According to some gynecologists, cancer of the vulva is rare. Brady (quoted by Stout), in reviewing 29,000 admissions for gynecological disease at the Johns Hopkins Hospital, observed only 27 cases of vulvar cancer; Stout did not observe any at the Presbyterian Hospital in a period of 10 years; Graves and Smith, in 1929, reported 21 cases observed at the Women's Free Hospital in Boston; and Clark and Norris, in their book *Radium in Gynecology*, reported 30 cases of carcinoma of the vulva among 1,119 specimens of malignant new-growths in the gynecologic laboratory of the University of Pennsylvania. These latter two authors quote Schaettlander and Kermaenner as saying these tumors represent from 2 to 4 per cent of all genital carcinoma.

Ewing says that cancer of the vulva is not rare. We find among 18,379 cases admitted to the State Institute from January 1913 to May 1, 1933, that 11,737 lesions were proved malignancies; that 1,587 of these involved the cervix uteri; 340 the fundus of the uterus; 83 the vagina; 204 the ovary; 118 the vulva; and 12 the female urethra. These 118 cases comprise 1 per cent of all our cancer cases and 5 per cent of all our female genital carcinoma, not including the urethra. This 5 per cent is more than would be observed in the average general hospital.

Among our records we also found 31 benign lesions of the vulva, as follows: 7 benign papillomata, 4 cysts, and 20 inflammatory lesions, including pruritus, eczema, kraurosis, abscess, leucoplacic vulvitis, 1 tuberculous ulcer, and other inflammatory lesions.

ETIOLOGY

Graves and Smith, in an article "Kraurosis Vulvæ" give an historical review laying stress on the confusion of this condition in the literature; and after clinical and histological study of cancer of the vulva, are convinced that leucoplacia and kraurosis are demonstrable in a large percentage of the definitely proved malignancies. In 21 specimens of epithelioma of the vulva they found kraurosis 14 times and leucoplacia 16 times. They are, therefore, of the opinion that kraurosis and leucoplacic vulvitis are in all probability phases of the same disease. Taussig is of the opinion that leucoplacic vulvitis frequently undergoes malignant change and that if this condition were treated surgically, the occurrence of cancer of the vulva could be reduced 50 per cent. Twenty-one of the 118 cases of vulvar cancer admitted to the Institute, showed evidence of leucoplacic areas, clinically.

In the histories given by the patients in our series, 52 per cent complained of itching and burning extending over a period of weeks, months, or years, before the establishment of malignant growths. It would seem from this that the changes associated with the conditions that produce the intense itching and burning in pruritus vulvæ must be regarded as an etiological factor on the theory that chronic irritation is one of the causes of malignancy. Ewing says that "The parakeratosis and round-cell infiltration of the corium in pruritus are distinctly favorable to the development of epithelioma." Other patients complained of pain and a bloody or purulent discharge which, at times, had a very offensive odor. Very few of them were cognizant of any growth being present.

One hundred and eight of the patients were married; 13 of whom were nulliparæ. Ten were unmarried and the others had from one to seventeen pregnancies.

Ages of patients at the time of admission:

Ages in years	Cases
25	1
30 to 39	8
40 to 49	30
50 to 59	23
60 to 69	34
70 to 79	20
80 to 83	2

The youngest patient in this series was 25; the oldest, 83.

In recording cancer of the vulva, we have included the labia, major and minor, the fourchette, the clitoris, and Bartholin's glands. The 12 cases of primary epithelioma of the female urethra and

TABLE I.—RESULTS OF TREATMENT IN GROUP I

	Cases
Admitted and treated 5 or more years ago	19
Free from disease—	
For 11 years	1
For 8 years	1
For 7 years	1
For 6 years	3
Palliation—lived over 5 years—	
Lesion controlled for 6 years when metastases developed in groins and patient died from local extension and metastases 7 years after admission	1
Lesion seeded and controlled for 5 years; death 5 years after admission	1
Deaths—	
In less than year	2
1 to 2 years	2
2 to 3 years	3
3 to 4 years, clinically well 2 years, 3 months	1
Clinically well 1 year—died from other causes	2
Lost trace of	1
Admitted and treated less than 5 years ago	8
Free from disease following original treatment—	
More than 4 years	1
For 2 years	1
For 8 months	1
For 6 months	1
For 2 months	1
Palliation—clinically well 4 years, local recurrence	1
Death from local extension and metastases in 1 year	1
Clinically well, death from other causes in 2 years, 4 months	1

metastatic tumors to the vulva from other parts of the genital tract are not included in this report.

In the 118 cases of cancer of the vulva, biopsy showed epithelioma 115 times in one of which there was a mixed lesion showing both pearl and basal cell epithelioma; and adenocarcinoma 3 times One of these adenocarcinomata definitely had its origin in Bartholin's gland; the 2 other adenocarcinomata were probably primary in some of the sweat glands of the vulva. These findings are in accord with Professor Ewing's statement that most of the malignancies occurring on the vulva are of epidermoid origin; that Bartholin's glands and sweat glands may also be the origin of adenocarcinoma.

Melanoma of the vulva is a rare disease but exceedingly malignant. Wright, in a recent paper, "Melanoma of the Labia," reported 2 cases and reviewed the literature. Leigher reported a basal cell epithelioma of the vulva in 1929 (Stout).

PATHOLOGY

Cancer of the vulva may occur as a thickening of the epidermis which soon becomes cracked or fissured; as a warty or papillomatous growth which is primarily malignant; a benign wart upon which the malignant process is ingrafted; or as an infiltrating type of growth which soon ulcerates giving rise to bloody or purulent discharge and pain. It is often associated with a history of pruritus vulvæ, kraurosis; or leucoplacic vulvitis.

Secondary infection with ulcerating or excoriated lesions causes a rapid proliferation and dissemination of the disease to lymph bearing areas.

In 62 per cent of our primary cases (those not operated upon before admission) the inguinal lymph nodes were distinctly enlarged. The spread of the disease from the vulva is by contiguity of tissue or through the lymph channels into the femoral and inguinal lymph nodes. Those lesions which have their origin in the clitoris or immediately surrounding it may metastasize through the deep lymphatics into the pelvis. Disseminated metastases do occur involving the abdominal and thoracic viscera. When syphilis is combined with epithelioma of the vulva, the prognosis seems to be more unfavorable. In our series, 11 cases were associated with syphilis. Nine of these patients died in less than 1 year; but 1 is living for over 6 years, and 1 died over 4 years after admission.

Multiple lesions involving the vulva have been observed. Whether they were due to lymphatic extension or direct contact, is difficult to state.

"Epithelioma of the vulva usually presents a structure of narrow cords and columns of relatively undifferentiated squamous cells. Hornification and pearl formation are not prominent. The malignant clinical character of the process is often apparent in the histological structure. In the advanced stages, the proportions of cells and stroma vary, and some authors speak of scirrhous and encephaloid types." (Ewing.)

TREATMENT

The treatment of cancer of the vulva whether by surgery, coagulation, or a combination of these methods with irradiation, or irradiation alone, has proved very unsatisfactory. This is especially true when the lesion on the vulva has attained any size and has existed for several months, as the problem then is not only eradication of the local lesion but the more difficult problem of eradicating metastatic nodes in the lymph bearing areas.

Taussig believes the treatment of choice is radical surgery. In a report of 49 cases of vulvar cancer treated over 5 years ago, of which 11 were operated upon radically, according to the Basset technique, he says that 81 per cent have resulted in 5 year healings. Two cases recurred, 1 at 5½ years, and 1 at 8 years, making an absolute cure of 63 per cent of these 11 selected cases. We are of the opinion that radical coagulation of the vulva and highly filtered X-ray or radium to the lymph bearing areas is applicable to a larger number of cases presenting themselves for treatment.

Cade, one of the English workers, fosters the implantation of radium needles into the vulva and surface applications of radium at 1½ centimeters distance over the groins.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Case M. C. Group I case before treatment was started.

Fig. 2. Case M. C. Photograph taken 7 months after coagulation of the vulva and high power X-ray treatment over the vulva and groins. Patient has remained free from the disease 7 years and 2 months.

Fig. 3. Case H. P. Group I case showing papillary type of growth. Admitted November, 1932.

We are cognizant of the fact that vulvar cancer treated surgically by vulvectomy and radical excision of the lymph bearing areas, when the lymph nodes do not show metastases, sometimes cures. However, when metastases are demonstrated in the lymph bearing areas, cures are very exceptional. In reporting the results of treatment of cancer of the penis (Schreiner), we demonstrated that radical surgery gave excellent results if there were no demonstrable metastases in the lymph bearing areas. From our experience, it would seem that the same thing holds true for vulvar cancer. Radical surgery would, therefore, have a very limited field for the cases presenting themselves for treatment at our institution.

The treatment of our series of cases has been, of necessity, changed from time to time as experience was gained. Patients treated prior to 1923, as we see it now, were very inadequately treated, especially radiologically. Better palliation resulted from coagulation of the local lesion and heavily filtered irradiation over the lymph bearing areas than from any other method.

Recently a few of the vulvar lesions, treated with heavily filtered radium needles inserted through the local lesion and heavily filtered radium packs to the lymph bearing areas, have responded so well that it has given us more hope.

Rentschler reports 71 cases treated in the Mayo Clinic by surgery, irradiation, and combinations, and concludes that only 13 were alive and free from the disease from 1 to 15 years.

In reviewing the work of the Teubinger Clinic, Tausch records 39 cases of vulvar cancer in which 19 per cent lived 5 years, but records only a 7 per cent absolute cure.

Schulz reports 3 cases alive 5 years after treatment, or 13 per cent of his 23 cases of cancer of the vulva. The report includes 43 cases but his statistics were based on 23 cases in which treatment was surgical.

Dr. Berven of Radiumhemmet, in response to a recent communication, stated that in 34.9 per cent of his cases patients have remained free from the disease 5 years or longer.

Delporte and Cahen in reviewing 11 cases of vulvar cancer treated by irradiation, both radium and X-ray, supplemented by surgery, report some healings of the primary lesions and regression of the enlarged nodes by irradiation but they also seem somewhat discouraged in view of the extreme malignancy of these lesions, especially when the lymph bearing areas are involved.

RESULTS OF TREATMENT

Our 118 cases were divided into three groups according to the amount of anatomical involvement. Twenty-seven cases in which the disease was local, no matter how extensive, but with no definite clinical signs of metastases in the groins, were placed in group I. Forty-four cases in which the lymph nodes in one or both groins were distinctly enlarged and were thought to be metastatic, fell into group II. Twenty of these cases

Fig. 4.

Fig. 5.

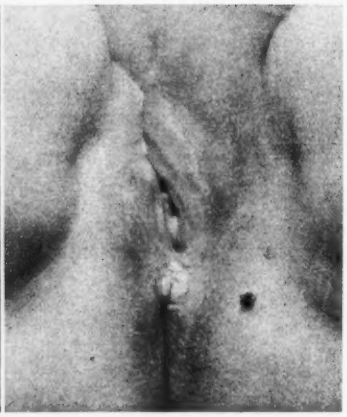

Fig. 6.

Fig. 4. Case H. P. Lesion healed following coagulation of the local lesion and high power X-ray treatment over the groins.

Fig. 5. Case E. T. Group II case before treatment.

Fig. 6. Case E. T. Photo taken 3 years after original treatment of coagulation of the local lesion and irradiation over the groins. This patient is alive over 7 years after admission.

were considered absolutely hopeless. Forty-seven of our cases had been treated surgically before admission. The patients had had either local excision of the lesion, or radical operation, followed by recurrence. These were placed in group III.

In only 72 of the 118 cases of cancer of the vulva were the patients treated 5 or more years ago.

TABLE II.—RESULTS OF TREATMENT IN GROUP II

	Cases
Admitted and treated 5 or more years ago	24
Living over 5 years—	
Lived 7 years, 6 months; free from disease 2 years, 10 months, then local recurrence which was treated and patient remained well for 4 years, 4 months when there was local recurrence which has been healed after further treatment, for past 3 months	1
Lived 6 years with no recurrence of local lesion since original treatment but nodes in both groins were retreated 2 years after admission; no palpable nodes since then	1
Deaths—	
In less than year	18
Hopeless at time of admission	10
In 1 to 2 years—local lesion well at time of death	2
In 2 to 3 years—local lesion well at time of death—case hopeless at time of admission	1
Not treated	1
Admitted and treated less than 5 years ago	20
Free from disease following original treatment—	
For 2 years, 9 months	1
For 2 years, 2 months—hopeless	1
Living July 1, 1933—	
For 3 years, 11 months, disease progressing	1
Free from disease for 2 and 9 months, respectively, nodes still palpable in groins—hopeless at time of admission	2
Clinically well 4 months, local recurrence—clinically well following further treatment for 5 months, now undergoing treatment for another local recurrence	1
Deaths—	
In less than year	11
Hopeless at time of admission	6
In 1 to 2 years	1
In 2 to 3 years	1
In 4 to 6 years—clinically well 2 years, recurrence and metastases	1

Nineteen of these cases were in group I, 8, or 42 per cent, have lived over 5 years but only 6, or 31.5 per cent, have remained free from the disease for a period of 5 years or longer (see Table I).

In these 6 cases the patients were treated in the following manner: 2 were treated only by radiation of the local lesion only; and 4, by irradiation of the local lesion, irradiation of the lymph bearing areas, followed by coagulation of the vulva.

None of the group II cases in this group of 72 cases resulted in 5 year healings, although 2 of the patients are living over 5 years and have been free from the disease for periods up to 4 years. Of course, 11 of these cases were considered absolutely hopeless before any treatment was administered. Ten of these died within a few months but 1 lived for over 2 years and the local lesion healed (see Table II).

Three of the 29 group III cases, treated 5 or more years ago, or 10 per cent, lived over 5 years. Two of them, or 7 per cent, have been free from the disease for a period of 5 years or longer. The other one suffered a recurrence after being free from the disease for 4 years and 10 months and died 6 years and 5 months after admission. One of the patients, counted as a 5 year healing, is living for 17 years after admission although she has had two local recurrences which responded to treatment (see Table III).

The absolute statistics of all the cases treated 5 or more years ago, regardless of clinical grouping on admission, are: 13 of 72, or 18 per cent, have

Fig. 7.

Fig. 7. Case A. A. Showing a rare tumor of the vulva—adenocarcinoma of Bartholin's gland. (Patient alive and well but have been unable to get photograph of healed lesion as patient does not report for examination.)

Fig. 8.

Fig. 8.

Fig. 8. Photographs of 2 cases, in neither of which the patients had had treatment at the time of admission. In both the condition was regarded as hopeless when patients entered the hospital.

lived 5 years or longer, 8 of 72, or 11 per cent, have been free from the disease for periods of from 5 to 11 years and are living since admission up to 17 years.

Forty-six of the patients were admitted less than 5 years ago; 8 in group I, 20 in group II, and 18 in group III.

Five of the 8 patients in group I are free from the disease since the time of their original treatment; 1 died from intercurrent disease after being clinically well for over 2 years; 1 was clinically well for 4 years when there was a local recurrence which is now undergoing treatment; and 1 patient died from extension of the local lesion and metastases in 1 year (see Table I).

Two of the 20 patients in group II are free from the disease for over 2 years since the time of original treatment. Four of the patients are living for from 2 months to 3 years 11 months from the time of admission: 2 of these are free from local recurrence for 2 months and 9 months, respectively, although the metastases in the groins are still palpable; 1 patient has been having palliation for over 3 years but the lesion is now progressing; and the fourth patient has been free from the disease for 4 and 5 month periods, but is now undergoing treatment for her third local recurrence. One patient who died 4 years after admission was free from the disease for 2 years when there was a local recurrence which progressed and caused death. The 13 remaining cases in this group died in from a few months to 3 years (see Table II.)

Four of the 18 patients in group III are free from the disease since the time of our original treatment; 1 for 3 years and 9 months, and the 3 others for 4 months to 6 months. Three patients are living at the present time. One was free from the disease for 2 years 6 months but now has large

TABLE III.—RESULTS OF TREATMENT IN GROUP III

	Cases
Admitted and treated 5 or more years ago	29
Free from disease—	
Living over 17 years—free from disease 9 years, 7 months; local recurrence treated; again free from disease 3 years; then recurrence which responded to treatment and patient now well for 4 years	1
Well 6 years	1
Deaths—	
Less than 1 year	17
1 to 2 years	3
2 to 3 years	3
6 to 7 years—free from disease 4 years, 10 months, then recurrence and death	1
Lost trace of	1
Not treated	2
Admitted and treated less than 5 years ago	18
Free from disease following original treatment—	
3 years, 9 months	1
6 months	1
5 months	1
4 months	1
Living July 1, 1933—	
Lived 2 years free from disease; now, 2 years, 6 months since admission, has large metastases in groins and local recurrence	1
Lived for 1 year, 3 months following treatment—local lesion remained healed but recurred and is progressing	1
Lived for 5 months, progressively worse	1
Deaths—	
In less than year	5
Local lesion well at time of death	3
In 1 to 2 years	1
In 2 to 3 years	2
Local lesion well at time of death	1
In 3 to 4 years, with local lesion well at time of death	1
Not observed since treatment	1
Not treated	1

metastases in the groins and a local recurrence; the 2 other patients are living for 5 months and 1 year, 3 months, respectively, but the disease is progressing. Nine patients died in from a few months to 4 years; 1 was not treated, and 1 has not been observed since treatment (see Table III).

CONCLUSION

1. Cancer of the vulva is a very malignant disease and prone to recur after apparent cure.

2. The only hope of eradicating cancer of the vulva is by its early recognition and radical destruction by coagulation plus heavily filtered irradiation.

3. Where the disease apparently was local, 42 per cent lived 5 years or more; 31.5 per cent were free from disease for a period of 5 years or more.

4. Healings of 5 years are very exceptional if there are metastases in the groins.

5. Radical treatment of early leucoplacic vulvitis and kraurosis is important in the prevention of cancer of the vulva.

6. Thirteen of the 72 cases admitted and treated 5 or more years ago, have lived over 5 years, or 18 per cent; and 8 of them are free from the disease, or 11 per cent.

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ENTEROGENOUS CYSTS

Report of Two Cases Associated with the Rectum

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ENTEROGENOUS or enteric cysts of true developmental origin have been described as occurring along every portion of the alimentary tract. They are of peculiar interest not only because of their rarity, but also because of the problem they present in clinical diagnosis and the speculation they stimulate as to their origin. The majority of reported cases have been in the ileocæcal region where their development has been satisfactorily explained by the presence there of the remnant of the vitelline duct, which remnant more often appears as a Meckel's diverticulum (6). Haggard and Drennen have recently published descriptions of interesting ileocæcal cysts. Even more striking are the mediastinal cysts, such as that in the child presented by Poncher and Milles. Among other authors, Salvin has described a large retroperitoneal cyst of intestinal origin, and it must of necessity fall into this same group. The retroperitoneal enterogenous cysts, however, are to be distinguished from those of urogenital and lymphatic origin lying in the same region. The location and histological character of the cysts in the 2 cases we are about to report point to their origin from the rectum and stamp them as unusually rare tumors. Evans in his thorough-going and exhaustive treatise on these anomalies cites a case of a very long diverticulum of the sigmoid, but does not refer to any cyst of the rectum. Petit de la Villéon presented a child of 2 years from whom he had removed a cyst embedded in the wall of the rectum. As has so frequently been the case, this child also exhibited other congenital malformations.

Histologically, the structure of such cysts is distinctly enteric. Indeed, a trained observer upon examining a section of cyst wall may be unable to distinguish it from normal intestine. Ewing, however, has emphasized the great variation which is possible in the microscopic appearance, a variation only limited by the actual elements of intestinal structure. Thus the section may contain smooth muscle, lymphoid tissue, and mucosa, the latter composed of cylindrical, cuboidal, or stratified epithelium. The lining may be flat or there may be marked papillary proliferation. This great variety in the lining may in some instances be accounted for by intracystic tension and in others by inflammation or lack of epithelial differentiation.

Many writers, especially Evans have placed emphasis upon the great prevalence of diverticula in the gut during early life. The epithelial origin of these diverticula in pig, rabbit, and human embryos has been well described in the classic paper of Lewis and Thyng, published 25 years ago. Should one of these epithelial buds lose its communication with the lumen, a potential cyst is formed. Hence the origin of the enterogenous cysts is thought to be in these small diverticula, and it becomes easy to understand that such cysts and diverticula may in reality be different phases of the same process. Following the same line of reasoning, it is not difficult to explain the location of a cyst in the intestinal wall, be it submucosal, intermuscular, or subserous. In addition, the tumor may lie at any point in the gut periphery, antimesenteric, mesenteric, or at an intervening site. Many of these cysts are actually found lying between the folds of the mesentery.

Two cases are presented herewith which serve to illustrate well the clinical and pathological features of enterogenous cysts associated with the rectum, and at the same time to emphasize certain contrasts in their characteristics.

CASE REPORTS

Case 1. E. A. C., a white woman, married, aged 48 years, was admitted to the Union Memorial Hospital July 9, 1923, complaining of a lump in her rectum. Eight years previously she had had an appendectomy. Two years previously she had begun to lose weight, although there were no symptoms beyond occasional attacks of indigestion. Eight months before admission she had for the first time experienced a sense of fullness in her rectum which frequently recurred. During the latter part of this period, a lump would occasionally project through the anus; it was easily replaced. There had been no bleeding nor had constipation been a feature. She was told by her family physician that she had cancer. Physical examination was negative except for the local condition. The rectal sphincter tone was good. There were no external or internal hæmorrhoids. Digital examination revealed a small cystic mass lying about 2 inches within the anal orifice and situated between the posterior wall of the rectum and the coccyx. The mass was about the size of a walnut, was tensely fluctuant, freely movable, and not tender. The mucosa over it was intact, and there was no bleeding caused by the examination. A diagnosis of a benign cystic tumor was made.

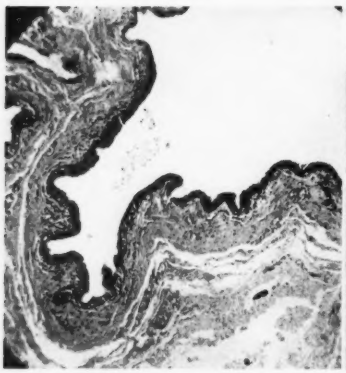

Fig. 1.

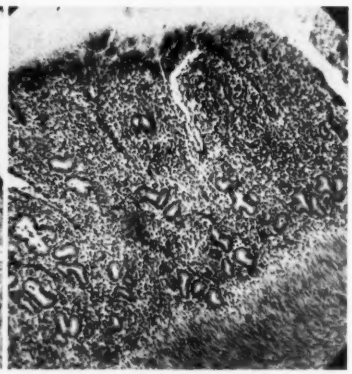

Fig. 2.

Fig. 1. Section through cyst wall in Case 1, showing atrophic type of mucosa.
Fig. 2. Section through cyst wall in Case 2. The similarity to normal intestinal structure is to be noted.

Operation. Under ether anæsthesia, operation was carried out by Dr. Stone. An incision was made posterior to the anus and a multilocular thin walled cyst identified. In order to obtain better exposure, the incision was extended and the coccyx removed. The cyst was then dissected away from the posterior rectal wall to which it was closely attached. The wound was closed in layers with drainage.

There was moderate pain following the operation and some infection in the wound. However, it slowly but steadily closed, and on August 13, 1923, the patient was discharged as well, with the wound completely healed.

Pathological report. Gross description: The gross specimen is a collapsed cyst, irregular in shape, measuring approximately 3 centimeters in diameter. The outer surface is rough and there are muscle fibers attached at various points. The wall of the cyst is thin and the interior is multilocular. The lining is shiny and is covered with a gelatinous material.

Microscopic description: The sections through the cyst wall show elongated folds composed of mucosa and submucosa within the lumen of the cyst. There is a definite atrophy of the mucosa characterized by fibrosis undergoing hyaline degeneration. The epithelium is tall and columnar, of a mucus-secreting type. The submucosa is composed of a loose, areolar connective tissue. The outer part of the cyst wall is composed of longitudinal and circular muscular layers covered by a layer of serosa. There is no evidence of any inflammatory process.

Diagnosis: enteric cyst.

Case 2. Baby J. W. J., male, aged 1 month, was admitted to the Union Memorial Hospital on January 30, 1932, with the complaint of vomiting and constipation. At birth he had weighed 8 pounds, 11 ounces; delivery had been spontaneous. There had always been a tendency toward constipation. For the last week he had lost weight, refused feedings, and vomited occasionally. There had been no bowel movement for 24 hours. Examination revealed a well nourished baby weighing 9 pounds, 6 ounces. The abdomen was soft; there were no masses nor evidence of visible peristalsis. The rectal sphincter was relaxed, and there was a mass covered with rectal mucous membrane projecting partially through the anus. On digital examination, the lower portion of the projecting tumor could be outlined as the finger passed around it. Above, however, it appeared to fill the rectum, and the examining finger could not readily pass it. There was apparently complete obstruction. It was concluded that we were dealing with an intussusception, and that the projecting mass was the intussusceptum. Immediate operation was advised.

Operation. Under ether anæsthesia, laparotomy was performed by Dr. McLanahan. The bladder, dilated to within 2 centimeters of the umbilicus, was encountered, and it was necessary to aspirate its contents before proceeding. Exploration of the abdominal cavity failed to reveal any evidence of intussusception. Deep in the pelvis, however, was a fluctuant mass, extraperitoneal and somewhat larger than a golf ball, pressing upon the rectum and the neck of the bladder. This tumor was inaccessible from the abdomen. The wound was quickly closed in layers and the child returned to the ward in fair condition.

The following day, in an effort to relieve the pressure, an aspirating needle was introduced into the mass, entering the skin at a point 1 inch to the right of the posterior margin of the anus. Twenty-five cubic centimeters of a cloudy fluid were withdrawn. This fluid contained occasional red blood cells and lymphocytes; culture was negative. During the succeeding month, the contents of the cyst were aspirated five more times, and each time about 25 cubic centimeters were removed, and each time the obstruction was temporarily relieved. Meanwhile, the infant continued to gain weight and improve.

Operation. On March 5, 1932, an incision was made to the right of the rectum directly over the cyst, which now when distended could be seen outlined in the perineum. The cyst wall was readily identified, and there was no great difficulty in dissecting it from the surrounding structures. It lay in close proximity to the rectal wall but did not appear actually to involve it. The wound was closed with drainage.

The wound drained for a time with some local infection, but gradually healed and the child was discharged on March 23, 1932, as well. The child has continued well and is developing normally.

Pathological report. Gross description: The gross specimen is that of a collapsed cyst which, when dilated, would approximately measure about 4 centimeters in diameter. The serous surface is of a greyish color and resembles an intestinal wall. There is considerable irregularity in the thickness of the wall. The lining of the cyst is soft, and covered with a gelatin-like substance.

Microscopic description: Sections show a well defined mucosa lined with columnar epithelium. The epithelial cells in some areas are of the tall, columnar, mucus-secreting type. There is a definite muscularis mucosæ and submucous layer. The outer wall, which shows considerable hypertrophy, is composed of two distinct circular and longitudinal layers covered by serosa. There is no evidence of any inflammatory process. The histological appearance of the microscopic sections is identical to that of an enteric tissue.

Diagnosis: enteric cyst.

The two cases reported show a marked discrepancy in age, and thereby illustrate an interesting feature in the clinical history of such tumors. The one case is an infant who almost certainly must have been born with a sizeable cyst, and the other an adult who had no symptoms until 47 years of age. The mechanical pressure of an enterogenous cyst, especially when it is located within the peritoneal cavity, may lead to obscure abdominal colic, and in many instances may bring about a true intestinal obstruction. Particularly is this true of the ileocæcal cysts which time and again have initiated an intussusception. Intestinal bleeding has often been attributed to the cysts, but probably occurs less often than in the case of the diverticula. In each case there was a failure to diagnose accurately the true condition, in the one case a diagnosis of malignancy having been made by the original examiner, and in the other a diagnosis of intussusception by the pediatrician and surgeon.

Histologically, the cysts are both characteristic of rectal structures. However, in each instance, a variety in the microscopic appearances is seen in the slide. At places the wall is thick, and at others thin. The epithelium especially shows a marked variation, in some areas proliferation and in others atrophy, while both columnar and cuboidal cells may be seen. The two sections shown (Figs. 1 and 2) illustrate contrasting fields.

The treatment has been satisfactory, depending finally upon the simple excision of a benign cyst in each instance. Such excision should always be carried out when an enterogenous cyst is suspected.

SUMMARY

Enterogenous or enteric cysts may occur along any portion of the gastro-intestinal tract, but are most common in the ileocæcal region and least common in the rectal area.

Histologically, they are composed of intestinal elements which may show great variations. Their origin is usually traced to the small diverticula of the gut occurring in fetal life, and it is thought that the diverticula and cysts appearing later are in reality different phases of the same process. Such an origin aids in explaining the location of the cysts with respect to the intestinal wall. Two cases of enteric cysts are reported, one in an adult of 48 years and one in an infant of 1 month. In each case the tumor lay in close association with the rectum and was successfully removed by the perineal route. Complete recovery ensued in each case. The microscopic sections showed the typical rectal appearance with expected variations in the epithelial structure. The possibility of an enterogenous cyst should be borne in mind in considering the differential diagnosis of a rare abdominal or rectal tumor and excision should be carried out when its presence is suspected.

We wish to acknowledge our indebtedness to Dr. Walter C. Merkel for the pathological reports.

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INDICATIONS FOR OPERATION IN GASTRIC SYPHILIS[1]

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THE relative rarity of demonstrable gastric syphilis and the diagnostic difficulties which this condition may present, contribute to the many interesting problems involved in the proper care of the patient with a definite gastric lesion associated with serologic evidence of syphilis. Gastric syphilis was found by Kirklin and Eusterman only three times in every thousand cases of syphilis. The persistent or recurring dyspepsia of syphilitic patients was found usually to be caused by neurosyphilis, or in the presence of an organic gastric or duodenal lesion, by carcinoma or gastric or duodenal ulcer. The question of primary importance which arises in each case is whether the gastric deformity visualized roentgenographically is actually of syphilitic origin or, on the contrary, a malignant growth occurring in a patient with syphilis. The importance of an accurate differential diagnosis in such cases is accentuated by the fact that the treatment of one is primarily surgical and of the other primarily medical. Although in some cases there are definite clinical and roentgenological criteria characteristic of syphilis of the stomach, in others it may be difficult to make a positive diagnosis of this condition without surgical exploration. A therapeutic test with antisyphilitic treatment, unfortunately, necessitates at least several weeks for trial; an undesirable delay if the lesion prove malignant.

Eusterman's outline of the typical features of gastric syphilis has greatly facilitated its clinical recognition. He emphasized that it occurs usually during the second to the fourth decade of life. The gastric symptoms are marked and progressive with an average duration of 2 years, and usually absence of an epigastric mass, retention, nausea, anæmia, cachexia and bleeding. In contrast, gastric carcinoma is more common among older persons. Usually, the symptoms are less prolonged, there is often a palpable mass, and anæmia, cachexia and bleeding may develop. If a palpable mass is present and the value for hæmoglobin is relatively high, gastric syphilis, rather than carcinoma, is suggested.

The roentgenological evidence of gastric syphilis described by Carman and Kirklin, although not absolutely pathognomonic in every case, usually aids materially in the differential diagnosis. Characteristically, in these cases, there is a circumscribed or diffuse concentric involvement converting the affected "segment into a narrow tube

Fig. 1. Portion of stomach removed; syphilitic gastritis and shallow serpiginous ulcers may be noted. Case 1.

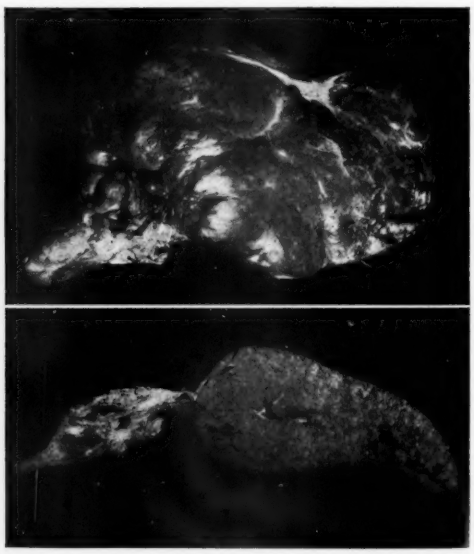

Fig. 2. Gross appearance (upper) and cross section (lower of liver; extreme atrophy of the right lobe and irregular en largement of left lobe may be noted. Case 6.

[1] Comments by Dr. Paul A. O'Leary and Dr. George B. Eusterman.

with a relatively smooth lumen of uniform caliber," in which there is no intrusion into the lumen of a distinct growth. There is usually some degree of "stiffening, lessened mobility, and absence of peristalsis." The roentgenological abnormalities may appear more extensive than the general condition of the patient would suggest, if the abnormalities were caused by a malignant growth. Moore and Aurelius stated that in 70 per cent of the cases studied the lesion was prepyloric and concentric; in 22 per cent, the lesion was of the dumb-bell or hourglass outline; and in 8 per cent, involvement was diffuse. Despite these supposed distinguishing features, the clinical diagnosis of gastric syphilis remains doubtful in some cases.

At the first examination, cases in which there is serological evidence of syphilis associated with a definite gastric lesion may be classified in three main groups, depending on the therapeutic indications and method of treatment: (1) cases in which the diagnosis of gastric syphilis can be established with a high degree of accuracy, according to the clinical and roentgenological criteria outlined, and cases in which all the clinical and roentgenological evidences of an inoperable gastric lesion are present, regardless of whether this appears to be syphilitic or malignant; (2) cases in which serological evidence of syphilis is incidentally associated with an operable, malignant gastric tumor or a non-specific inflammatory gastric lesion which definitely requires operation because of obstruction, perforation, the possibility of malignancy or some other reason which renders medical care insufficient; and (3) cases in which there is serological evidence of syphilis associated with a definite gastric lesion the clinical diagnosis of which is indeterminate between malignancy and syphilis. Depending on the conditions surrounding the individual case, combined surgical and medical treatment, or medical treatment alone, will be indicated. In brief, cases in group 1 are usually primarily medical, whereas in those of groups 2 and 3 exploration should be carried out. Five illustrative cases in which we operated have been selected for presentation.

Cases classified in the first part of group 1 can be diagnosed with considerable accuracy because they present all the characteristic clinical and roentgenological criteria of gastric syphilis. Consequently, antisyphilitic treatment should be instituted unless the lesion is causing marked obstruction, in which event operation for its relief may be necessary. As a rule, however, antisyphilitic treatment affords remarkable results, and operation is indicated only when the lesion does not heal, or when during the course of healing, marked constriction results in obstruction. It is interesting in this connection that Eusterman found no improvement in 10 per cent of the 93 cases of gastric syphilis in which antisyphilitic treatment was given, although in 79 per cent complete cure or very great relief was obtained. In the 11 per cent remaining, some improvement was noted. In those cases, classified in the second part of group 1, in which an unusually extensive roentgenological deformity was present, or one was so situated and so fixed to surrounding structures that it appeared inoperable, even although it suggested malignancy, gratifying results may be obtained from vigorous antisyphilitic treatment. Occasionally, even a patient with a malignant gastric lesion may show some temporary improvement due to the non-specific effect of antisyphilitic treatment.

REPORT OF CASES

GROUP 1, CASE 1. Clinical diagnosis of gastric syphilis. Failure of patient to improve under a brief antisyphilitic regimen.

A woman, aged 61 years, registered at the clinic October 31, 1932, with the complaint of indigestion of 1 year's duration. This was characterized by bloating, belching, and epigastric soreness. There was no nausea or vomiting. The patient was unable to eat an average size meal, despite a good appetite, because the stomach "filled up so quickly." There was a loss of 30 pounds during the last year.

Physical examination was essentially negative except for the obvious loss of weight and moderate epigastric tenderness. The Kline and Kahn reactions were positive. Analysis of gastric content gave evidence of no free hydrochloric acid and a low total acidity, and one specimen contained a small amount of blood. Roentgenological examination revealed an ulcerating lesion of the middle third of the stomach somewhat suggestive of carcinoma. Clinically, the diagnosis of gastric syphilis was considered probable and it was thought justifiable to give the patient a short course of antisyphilitic treatment, rather than advise immediate exploration. Arsphenamine, iodides, and bismuth were employed for 2 weeks with but slight improvement in symptoms, and no roentgenological evidence of change in the gastric lesion, and so operation was advised.

November 18, 1932, partial gastrectomy of the posterior Pólya type was performed for an obstructing tumor in the lower third of the stomach. The tumor was soft and felt somewhat like a papillary carcinoma, but it was impossible to be certain of its exact nature at that time. Because of the indeterminate diagnosis, the failure to respond to medical treatment, and the readily resectable nature of the lesion, its removal seemed definitely indicated. Some hepatic cirrhosis was present. Pathological study revealed syphilitic gastritis with multiple shallow serpiginous ulcers; the submucosa thickened, and marked perivascular infiltration of lymphocytes and plasma cells (Fig. 1).

Convalescence was uneventful. Six months after the operation, the patient stated that she had gained weight, felt well and was able to return to her former duties.

A case of this type introduces the question of how long antisyphilitic treatment should be given before it is decided to be ineffectual. The opti-

mum length of time will vary somewhat, depending on the circumstances involved in each case. As a rule, however, definite improvement is noticeable in 2 or 3 weeks if antisyphilitic treatment ultimately is to prove satisfactory. Occasionally, when complete or partial healing of a syphilitic gastric lesion occurs, under the influence of antisyphilitic treatment obstruction may result because of constricting fibrotic changes, which develop during the process of healing. In these cases operation may be required because of symptoms of obstruction.

GROUP 1, CASE 2. Disappearance of apparently inoperable gastric lesion under antisyphilitic treatment.

A woman, aged 44 years, came to the clinic February 20, 1933, complaining of persistent, dull, epigastric pain of 4 months' duration. The pain often radiated to the back or right lower abdominal quadrant, and was likely to be more severe when the stomach was empty. There was some associated bloating, nausea, and occasional vomiting which ingestion of alkaline powders failed to relieve. The patient lost 12 pounds.

Physical examination was negative except for moderate tenderness and an indefinite sense of resistance above and slightly to the right of the umbilicus. The Kline and Kahn tests both gave strongly positive reactions. Analysis of gastric content revealed an absence of free hydrochloric acid and a low total acidity; there was no retention. Roentgenographic examination of the stomach revealed an extensive lesion of the cardia and fundus, interpreted as probably an inoperable carcinoma. Clinically, it seemed as though a carcinoma of this size would have produced a greater systemic effect and possibly have formed a palpable mass. For these reasons and because of the inaccessibility of the lesion, antisyphilitic treatment was begun March 1, 1932. Roentgenological examination 8 days later did not give evidence of change, but April 3, it disclosed an apparently normal stomach without visible evidence of deformity. At this time the patient felt well, had gained weight and had no gastric symptoms. The original roentgenographic interpretation of the gastric deformity as a malignant lesion apparently was erroneous, as shown by prompt disappearance of lesion under antisyphilitic treatment.

In group 2, if the malignant or non-specific inflammatory lesion definitely requires operation and is incidentally associated with serological evidence of syphilis, prompt surgical treatment should be instituted before antisyphilitic treatment is tried. As mentioned previously, the mere finding of a positive Wassermann reaction in cases in which the complaint primarily is of gastric symptoms, is no indication of the true nature of any coexisting gastric lesion, as in the majority of cases this will not prove to be of syphilitic origin. These cases are often encountered, as the syphilitic patient may have any type of gastric change as readily as the non-syphilitic patient. The history, clinical examination, and roentgenological evidence aid in determining the character of the gastric change. Antisyphilitic treatment should be instituted as soon as convalescence permits.

In group 3, systemic syphilis is associated with indeterminate gastric change. These cases are of particular interest as the treatment varies with the extent and situation of the lesion and the accuracy of the diagnosis. If it is impossible to distinguish clinically with any degree of accuracy between gastric syphilis and carcinoma, when the lesion is easily resectable and situated in the pyloric portion of the stomach, abdominal exploration is definitely indicated.

The recognition of gastric syphilis at the time of exploration often affords some difficulty and depends largely on the surgeon's familiarity with the gross characteristics of this disease. Unfortunately, microscopic studies at the time of operation are of little value except to exclude malignancy. Because of these facts, the recent contribution of Meyer and Singer is of particular value in emphasizing the diagnostic features of gastric syphilis as seen by the surgeon. The differential diagnosis is usually between carcinoma and syphilis. The syphilitic lesion appears inflammatory. The walls of the stomach are diffusely thickened, somewhat injected, and not associated with a firm, localized lesion having the feel of malignancy. Meyer and Singer emphasize the disparity between the size of the roentgenological defect and the actual anatomical change palpable in cases of gastric syphilis. The former frequently indicates a large deforming lesion, which is not demonstrable at the time of exploration. They believe that the infiltrate found in these cases, chiefly in the submucosa, accounts for the extensive roentgenological abnormalities often observed.

In some cases there are other visceral lesions suggestive of syphilis associated with pathological changes in the stomach. If the diagnosis still remains in doubt at the time of exploration, the lesion should be resected in order to avoid the possible misfortune of leaving a malignant growth. Likewise, if it is thought that the lesion is syphilitic and definite obstruction exists, or if the lesion is such that this might occur following antisyphilitic treatment, operation is advisable. If, on the contrary, at the time of exploration a definite and extensive syphilitic lesion is found in the stomach, possibly associated with marked syphilitic changes in the liver or other organs, it is best to close the wound and subsequently to institute antisyphilitic treatment.

GROUP 3, CASE 3. Indeterminate clinical diagnosis. Gastric endothelioma removed from syphilitic patient.

A man, aged 55 years, came to the clinic September 10, 1930, complaining of generalized weakness of 5 months' duration. One month previously emesis of dark red blood had occurred; otherwise a history of stomach trouble was not elicited.

Physical examination disclosed slight epigastric tenderness. The Kline test gave a positive reaction. Analysis of gastric content revealed that the acids were normal, but there was some evidence of retention. Two roentgenological examinations of the stomach did not reveal a recognizable lesion. The clinical diagnosis, therefore, remained in doubt. However, with the definite history of gastric hæmorrhage, which recurred during the course of examination, exploration seemed indicated, as a small, high lying, malignant lesion might be present. The patient was placed in a hospital for a period of pre-operative preparation as the concentration of hæmoglobin was only 20 per cent (Dare) on admission. After fluids had been given liberally and four transfusions of blood, the patient's condition improved and exploration was performed.

September 23, 1930, a partial gastrectomy of the posterior Pólya type was carried out. A mass about 7 by 6 by 6 centimeters was found on the lesser curvature at the juncture of the upper and middle thirds of the stomach. There was an ulcer on the anterior wall of the duodenum, about 1 centimeter in diameter. At exploration the tumor was thought to be a sarcoma. As there was no demonstrable nodal involvement and because the tumor could be removed, extirpation of the lesion seemed advisable. Approximately three-fourths of the stomach was resected. Pathological examination of the tissue revealed a malignant endothelioma arising from the peritoneal surface of the stomach. The tumor, which involved the musculature of the gastric wall, had also produced a small area of ulceration on the mucosa. Antisyphilitic treatment was instituted when the patient was dismissed from the hospital.

Convalescence was without event. The patient's general condition was excellent on dismissal from observation, and 1 year after operation, he was in good health.

GROUP 3, CASE 4. Indeterminate clinical and surgical diagnosis. Resection of a probable syphilitic gastric lesion.

A man, aged 42 years, came to the clinic August 19, 1932, complaining of stomach trouble of 8 months' duration, characterized by anorexia, epigastric fullness, and occasional vomiting. The symptoms were persistent but not severe. There was a loss of 15 pounds. A history of a penile lesion in 1929 was elicited.

Physical examination was essentially negative. Kline and Kahn tests gave negative results. Analysis of gastric content revealed no free hydrochloric acid and only a low total acidity, and a moderate degree of retention. Roentgenological examination disclosed an annular lesion at the outlet of the stomach presenting the characteristics of syphilis. As there was no clinical evidence of syphilis and the possibility of gastric malignancy could not be absolutely excluded, exploration was advised.

August 25, 1932, resection of the posterior Pólya type was performed for an obstructing mass at the lower end of the stomach. On gross examination it was impossible to determine with any degree of accuracy whether the lesion was inflammatory or malignant. Because of this and because of the mobility of the lesion, resection was performed in the usual manner, removing the lower half of the stomach. Examination by pathologists revealed probable syphilitic gastritis with perivascular infiltration of lymphocytes and plasma cells. Convalescence was uneventful.

The patient improved greatly after operation. When last heard from, 9 months later, he was in fair general health but occasionally had some digestive disturbances.

GROUP 3, CASE 5. Indeterminate clinical diagnosis. Gastric syphilis diagnosed by surgical exploration.

A man, aged 51 years, came to the clinic, April 4, 1933, complaining of fatigue and loss of 15 pounds in the last 6 months. For the previous 3 months constant epigastric distress had been present which was unrelieved by ingestion of alkaline powders. Although the appetite remained fairly good, an average size meal could not be eaten because of epigastric fullness. Syphilitic infection was denied.

Physical examination revealed a moderately enlarged and irregular liver. The Kline and Kahn tests gave positive reactions. Fractional analysis of gastric content revealed absence of free hydrochloric acid, low total acidity and a small amount of fresh blood. Roentgenographic examination of the stomach disclosed a deformity in the pyloric region, thought to be caused by an operable carcinoma. There was also an area of irregularity in the middle segment of the greater curvature which suggested the possibility of a second lesion.

The absence of any syphilitic stigmata, the age of the patient, the irregularly enlarged liver, the short, persistent course of the symptoms, the detection of blood on analysis of gastric content, and the roentgenographic findings, all suggested the probability of gastric carcinoma, rather than a syphilitic lesion. The latter diagnosis could not, however, be definitely excluded. Under the circumstances, exploration seemed indicated.

At operation, April 7, 1933, the lower two-thirds of the stomach was found to be involved in an œdematous infiltrative process which had the appearance and feeling of a diffuse, inflammatory lesion. There was some irregularity palpable on the posterior wall and greater curvature. The serosal surface of the stomach was œdematous and vascular. An enlarged gland in the gastrocolic omentum was removed for diagnostic purposes and reported to be inflammatory. The liver presented a remarkable example of tertiary syphilis for which the name hepar lobatum is most applicable. The left lobe was contracted, forming globular shaped masses, about 5 centimeters in diameter, and the right lobe was deformed with multiple indentations and nodules. The surface of the liver was covered with a plastic fibrinous exudate and presented a mottled, cherry red and mulberry, granular appearance. Further exploration was negative except for the presence of a small amount of free fluid within the abdomen. It was thought that the gastric and hepatic lesions undoubtedly were the results of tertiary syphilis. The operation was concluded as an exploration.

Immediate convalescence was without event. Mild antisyphilitic treatment, with mercury only, was instituted because of the hepatic involvement. Frequent roentgenological examinations of the stomach were advised. Unfortunately, antispyhilitic treatment for a period of 7 weeks did not relieve the patient, and he returned recently, complaining of excessive vomiting. Clinical and roentgenological evidence corroborated the diagnosis of pyloric obstruction. Following a few days' preliminary preparation, operation was performed July 4, 1933, at which time a posterior gastro-enteric stoma was made for obstructing, sclerotic, syphilitic gastritis situated in the pyloric region. There was marked ascites at the time of operation, and the parietal peritoneum and viscera appeared inflamed. The liver was still markedly deformed and seemed a trifle smaller than it did at the time of the first operation. The stomach was greatly dilated. The diffuse nature of the gastric lesion noted at the previous operation had changed to a more localized, obstructing, inflammatory condition in the distal half of the stomach. There was no discernible evidence of a malignant lesion. Evidence of hepatic decompensation developed in this case before dismissal, characterized by the development of abdominal ascites requiring paracentesis. In fact, paracentesis was necessary once or twice after the patient returned home but recently he has improved remarkably. When last heard from, 5 months following operation, the patient was gaining weight and was in excellent general health. His appetite was good and he made no complaints of digestive trouble. He was con-

tinuing with the inunctions of mercury and with the taking of iodides by mouth.

GROUP 3, CASE 6. Exploration for suspected gastric tumor. Syphilitic hepatitis and probable syphilitic gastritis disclosed.

A man, aged 67 years, registered at the clinic November 27, 1933, complaining of intermittent attacks of epigastric distress following meals for a number of years. Hæmatemesis occurred on three different occasions. In the last few months he had lost some strength and 5 pounds.

Physical examination gave essentially negative results except that an irregular mass was palpable in the epigastrium and left upper part of the abdomen. The concentration of hæmoglobin was 24 per cent and erythrocytes numbered only 1,760,000 per cubic millimeter of blood. The Kline and Kahn tests were both strongly positive. Roentgenographic examination of the stomach, November 28, 1933, revealed slight cardiospasm and the presence of food in the stomach; the second examination, November 29, 1933, disclosed what appeared to be a polypoid growth in the distal two-thirds of the stomach, which was thought to be benign and operable, although the examination was not entirely satisfactory to the roentgenologist.

The patient was hospitalized November 28, 1933, and received two blood transfusions and one injection of neoarsphenamine before operation, which was performed December 6, 1933. On exploration, the mass that previously had been palpated was found to be caused by extensive syphilitic hepatitis. The left lobe of the liver was greatly enlarged and irregular in outline, and the right lobe was markedly atrophied. The entire liver presented a purplish-brown appearance and the lobular deformity characteristic of syphilis. The surface of the liver was covered by fibrinous adhesions between the dome and the parietal peritoneum above it. There was no evidence of a primary gastric lesion, but mild, diffuse gastritis, evidenced by petechial hæmorrhages in the subperitoneal coat, existed throughout the entire organ. The spleen was moderately enlarged and was adherent to the peritoneum. The anterior wall of the stomach was incised in order to permit inspection from within, but a tumor was not disclosed. A specimen for biopsy was removed from the stomach and one from the liver. With the hope of preventing subsequent hæmatemesis, the left coronary vein was divided and ligated.

The pathologists reported chronic hepatitis with interlobular fibrosis and lymphocytic infiltration. There was evidence of degeneration and regeneration of hepatic cells, and the picture presented was considered to be not inconsistent with that of hepar lobatum. A specimen from the gastric wall disclosed an inflammatory reaction.

Postoperative convalescence was fairly satisfactory until December 10, 1933, when patient suddenly became weak, and large, tarry stools were passed. Despite all types of supportive treatment, he failed rapidly, and death ensued.

Postmortem examination disclosed a large, recent gastrointestinal hæmorrhage which apparently arose from esophageal varices. Multiple gummas were found in the spleen. There was extensive cirrhosis. As noted at the time of operation, there was atrophy of the right lobe of the liver, grade 3, and marked enlargement of the left lobe (Fig. 2). The surface of the liver was nodular and presented many puckered scars. The liver cut with increased resistance, and on the interior were many yellowish nodules and an excessive amount of connective tissue. The remainder of the examination revealed nothing of unusual interest.

COMMENTS

DR. O'LEARY: If a patient with syphilis has a demonstrable lesion in the stomach, the differential diagnosis usually includes gastric carcinoma and gastric syphilis. If the roentgenogram reveals the lesion to be situated so that it is operable, it is essential not to delay operation so long that the chance for cure will be lost if carcinoma is present. The therapeutic test for syphilis offers, in many of these cases, a means of distinguishing between gastric carcinoma and gastric syphilis in a comparatively short time. The test is best undertaken with the patient in hospital where arsphenamine can be given weekly, and mercury or bismuth daily, or less frequently according to the preparations used. Besides recording the weight daily, food should be given five or six times a day because of the reduction in the capacity of the stomach. Frequent estimations of the hæmoglobin content and erythrocytes may be of aid, at the same time bearing in mind that one of the significant clinical findings in gastric syphilis is the relatively normal concentration of hæmoglobin and number of erythrocytes in the presence of a gastric lesion accompanied by marked loss of weight. In the presence of a palpable gastric mass, an appreciable decrease in the size of the tumor during the course of the therapeutic test is also significant. The patient with gastric syphilis of the nodular, ulcerated, or circumscribed types usually improves rapidly under this regimen. Within a few days he is able to eat increasing amounts of food with a steady decrease in discomfort after eating, and a sense of increased well being; the weight and hæmoglobin content increase steadily. In this type of case interpretation of the therapeutic test is not difficult, and continued treatment results in complete relief of symptoms in a high percentage of cases. Unfortunately all patients with gastric syphilis do not show such phenomenal response because if the process is diffuse and infiltrative, or if the stomach is contracted and fibrotic, considerable difficulty will be experienced in interpreting the results of the therapeutic test. In such cases improvement is slow and decidedly less marked, or if the lesion is of many years' standing and fibrosis advanced, there may be no relief of symptoms. The decision to explore in these cases is based on the fact that in the presence of an operable lesion and in the absence of response to antisyphilitic remedies, attempts at surgical cure must not be delayed until lymphatic involvement occurs. However, in certain of the cases of this group if the therapeutic test is extended over a period of 4 to 6 weeks, sufficient systemic improvement may occur to warrant the diagnosis of gastric syphilis. The roentgenogram is not of much aid in the interpretation of therapeutic effects because the contracted stom-

achs do not show any change in the deformity following antisyphilitic treatment.

The danger of surgical procedures in cases of gastric syphilis lies in the unnecessary excision of a gummatous gastric lesion, the subsequent extension of the syphilitic process, and the resulting increased gastric deformity. In cases of syphilitic gastritis with fibrosis gastro-enterostomy or partial gastrectomy may give considerable relief. Likewise the opportunity for examination of the liver at the time of operation may give valuable information as to the type and amount of antisyphilitic treatment permissible, depending on the degree of hepatic involvement.

It is of interest to note the so called non-specific effect which the patient with syphilis and gastric carcinoma may derive from arsphenamine and bismuth or mercury. A slight gain in weight and appetite during the first 2 weeks of a therapeutic test may slightly simulate the effect of treatment. The degree of improvement, however, is temporary and less marked, and not so complete as that observed in cases of gastric syphilis.

DR. EUSTERMAN: Surgical contributions concerning a rare type of visceral syphilis, which more frequently simulates malignant lesions of the stomach than any other entity, are highly important and timely. Knowledge concerning gastric syphilis has been greatly extended in the last 15 years, due largely to the collaboration of the clinician, roentgenologist, and syphilologist, in addition to evidence afforded by pathological and bacteriological study of resected material. Yet in spite of these advances one cannot escape the conviction that too often the specific nature of the lesion was not established, or even suspected, until after its surgical removal. Speaking generally, if a dyspeptic patient in the thirties or early forties, presents serological or clinical evidence of systemic syphilis, or both, who is not cachectic or anæmic as a rule, and who on further examination has no palpable epigastric mass and no undue retention of gastric content, but who invariably has achlorhydria and a gastric filling defect usually indistinguishable from that of gastric carcinoma, it is highly essential to exclude the syphilitic nature of the gastric lesion. On the other hand, an elderly patient with recent onset of gastric disturbances who exhibits variable degrees of cachexia, in association with a palpable mass or gastric retention, or both, invariably harbors a malignant lesion even if frank evidence of coexisting systemic syphilis is at hand. Diagnostic teamwork on the part of the experienced clinician, the surgeon, and the syphilologist will successfully disclose the nature of the lesion in the majority of the doubtful cases without in any way militating against the chances for the patient's recovery even though the lesion should eventually prove to be malignant.

Two other factors warrant brief consideration: First, pyloric obstruction or tumor, or a combination of both in the same case, is not necessarily an indication for immediate surgical intervention. If these patients are young, the favorable results of antisyphilitic treatment may be as spectacular as in the uncomplicated cases. Undoubtedly the lesions under consideration were not in an advanced stage, as the tumor disappeared promptly and the obstruction was relieved within a short period. But inasmuch as tumefaction and pyloric obstruction, or gastric retention, are three to four times as common in malignant conditions as in gastric syphilis, the possibility that the lesion is malignant must always be regarded seriously, especially if the patient is elderly. Second, my own experience is in accord with that of O'Leary, Singer and others, that in the more advanced syphilitic lesion the results of antisyphilitic treatment are not appreciable sometimes until after 4 to 6 weeks have elapsed. When the evidence favors the syphilitic nature of the lesion, or if by virtue of its position or extent, as determined roentgenoscopically, it is inoperable if malignant, such extension of treatment, which is necessary at times, seems justified. Concerning the improvement following the use of arsenicals in cases of carcinoma, with which I have never been impressed, it must be remembered that there is never any anatomical change for the better in the lesion, which is fundamentally important.

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VESICOVAGINAL FISTULA AND TECHNIQUE OF REPAIR

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A FISTULA between the vagina and the bladder may arise from any one of four causes. In cases encountered at The Mayo Clinic in the past 2 years, judging from the histories given by the patients, the most common cause has been difficult obstetric deliveries, with forceps. The second cause in order of frequency was some form of pelvic operation, usually hysterectomy; the third, advanced carcinoma of the uterine cervix; and the fourth, cancer of the uterine cervix which had previously been treated with radium. A fifth cause, which might be added, is prolonged use of an ill fitting vaginal pessary.

Several competent authorities have denied that the use of forceps, in itself, causes injury to the bladder, but that the prolonged labor in which it is eventually necessary to use instruments often produces such pressure on the anterior vaginal wall that the blood supply is materially affected. That this may be true is shown by many reports of cases in which the fistulas did not appear until several days after termination of labor. It is difficult to arrive at a close estimate of the frequency with which obstetric procedures cause fistulas, except through examination of material collected in a large obstetric clinic and even such an estimate would be unreliable with respect to the practice of obstetrics in general. In The Mayo Clinic, it was thought advisable to use forceps in 269 cases in the past 2 years. In some of these, forceps were applied merely to lift the head over the perineum after episiotomy had been performed. Fistula did not result in any of these cases. Hysterectomy of various types was performed in 1,067 cases in this same period of 2 years, in only one of which a vesicovaginal fistula occurred. This incidence probably cannot be applied generally, however, for the operations were performed by surgeons who specialize in gynecology.

Of 24 cases of vesicovaginal fistula encountered at the clinic in 1931 and 1932, the condition had followed hysterectomy in 8 cases. Prolonged and difficult labors preceded the appearance of fistula in 7 other cases, and in 7 of the remainder there was carcinoma of the uterine cervix. One of the fistulas followed an attempt at repair of a congenital anomaly of the base of the bladder and urethra, and one followed vaginal cystostomy for tuberculous cystitis.

The ages of these 24 patients varied from 14 to 76 years, most of them were in the fourth to the sixth decades of life, corresponding to the child-bearing age and to the age at which hysterectomy is most often performed. Two of the women were not married; both of them were less than 20 years of age when the fistula formed.

Ordinarily diagnosis of vesicovaginal fistula is easy. In addition to the incontinence, which is usually accurately localized by the patient, there is an ammoniacal odor, sometimes intermittent fever, hæmaturia, and often excoriation of the vaginal mucous membrane, and sometimes of the adjacent skin. When the internal orifice of the fistula is high in the base of the bladder, there may be no leakage of urine for short periods while the patient is standing. If the fistula is small, she may be able to pass appreciable amounts of urine through the urethra. Examination of the vagina through a speculum is usually sufficient, but it occasionally becomes necessary to inject some dye into the bladder so as to distinguish the vaginal opening definitely. When the fistula is small, it is best to have a cystoscopic examination as well, at which time a thread often can be passed through the fistula and left in place to serve as a guide to the surgeon.

Treatment of vesicovaginal fistula in the absence of malignancy is usually surgical. In a few cases, in which the fistula follows delivery, observation for as long as 6 months is justifiable provided improvement is apparent for occasionally this type of fistula closes spontaneously. No attempt at closure should be made until complete involution of all pelvic organs has occurred. Deutschman recently reported 4 cases in which no operative procedure was necessary, even though the fistulas in 2 of the cases were rather extensive when first seen. Malignant growths of the uterine cervix which have extended into the base of the bladder, and subsequently caused sloughing, with consequent leakage into the vagina, are not amenable to surgical treatment.

Pioneer work on methods of repair of vesicovaginal fistula was done by Sims in the middle years of the last century. Our method of repair whenever possible, is a modification of that proposed by C. H. Mayo in 1916 and later amplified by Judd and by Mayo and Walters. After a thread is passed through the fistula at cystoscopic examination, the patient is sent for operation. With the patient in the lithotomy position, the thread is utilized to draw a silver wire through the fistula to serve as a durable guide during dissection of the tract. The vagina is incised in the transverse direction on each side of a circular cut about the fistula, and the base of the bladder is separated from the anterior vaginal wall. With the wire as a guide, dissection is carried well up toward the mucosa of the bladder, and a pursestring suture of No. 00, 20-day, chromic catgut is placed in the muscular layer. The greater part of the fistulous tract is excised, and the vaginal end of the wire is grasped in a blunt hæmostat. By making traction on the other end of the wire, the stub of the fistula is inverted into the bladder and the pursestring is pulled tight. Reinforcing sutures, also of chromic catgut, are placed in the longitudinal axis, and the transverse cut in the vaginal wall is closed separately, using interrupted sutures of silkworm gut (Fig. 1). When the two lines of suture can be separated by normal tissue, the chances of permanent closure are good. As a final step, a retention catheter is placed in the bladder, to be left about 10 days. Some authors advise against the use of a catheter, and in cases in which the fistula is in the neck of the bladder, and the catheter would be in direct contact with the site of closure it would probably be safer to keep the bladder from becoming distended by careful use of a small glass catheter every 3 hours. In a few cases in which the vaginal approach is impracticable, either because of the position of the fistula or because the vaginal orifice is so small that extensive lateral episiotomy would be necessary for exposure, it is advisable to use a transvesical approach. A complete review of the development and application of this operation, and the bibliography has recently been published by Sears. Occasionally, when the fistula is high and the vagina small and narrow, intra-abdominal separation of the base of the bladder from the vagina and closure of the two openings separately, may give satisfactory results.

It may be noted that the suture material used by us is entirely of the absorbable variety with the exception of the silkworm gut sutures in the vaginal wall. Formerly, silk wire was used extensively for this purpose but we do not consider that it has any advantage over the suture materials now available.

The description of the operation makes it seem so simple that one might expect uniformly satisfactory results, but such is far from the truth. Repair of the fistula is not effected at the first attempt as a rule, as was seen in the review of cases encountered at the clinic in the past two years. Of 24 patients who presented themselves with vesicovaginal fistulas, the condition of 17 was considered to be suitable for operation. There had already been 48 attempts at closure on these 17 women. While they were under care at the clinic, it was necessary to do 23 operations. Four of them are not entirely cured as yet, and the end-result of treatment of 1 other is questionable.

Usually, if the operation is carried out the first time, as suggested, and if the fistula is 1 centimeter or less in diameter, good results can be expected. However, the prognosis of any one attempt is not good if the field in which one is working is mainly scar tissue resulting from previous operations. Sometimes it is impossible to secure sufficient tissue with adequate blood supply to allow closure of the defect, and transplantation of the ureters into the sigmoid becomes necessary. It is probably wise to transplant the ureters in two stages, although in selected cases Coffey's technique 2, in which both ureters are catheterized and transplanted at the same time, undoubtedly is highly satisfactory (Fig. 2). Transplantation has been done in several cases, one of which is reported in this paper. Lower and Phaneuf each have reported recently a similar case, in which pregnancy occurred later and successful delivery was accomplished by cæsarean section.

The use of electrocoagulation has been suggested in recent years, mainly by European surgeons. Peterson reported 2 cases in this country in which union was secured by this means alone; both of the fistulas were small. We have had no extensive experience with this method, but feel that best results are secured from this procedure when the fistula is not more than 1 or 2 millimeters in diameter, and then it should only be used in selected cases.

The 3 cases now to be reported illustrate different etiologic factors and methods of treatment.

CASE 1. An unmarried woman, 19 years of age, was delivered of a child at full term. Delivery was difficult and the use of forceps was necessary. Complete laceration of the perineal floor resulted, with laceration of the anterior vaginal wall, and separation of the symphysis pubis. The resultant rectovaginal fistula was repaired, union of skin and mucous membrane being secured, but not of the muscle layers, so that there was inadequate control of the

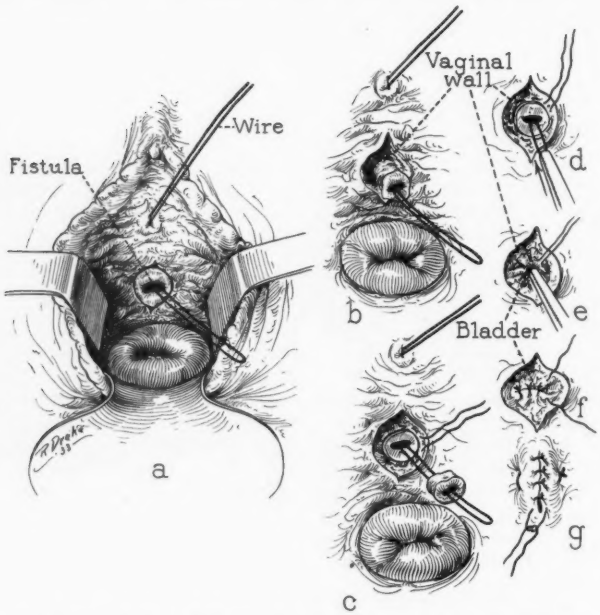

Fig. 1. Technique of closure of vesicovaginal fistula. *a*, The fistula is circumscribed, and a wire is run through the urethra into the bladder and out through the fistula. *b*, The fistulous tract is coned out. *c*, Any excess is excised. *d*, Tension is made on the wire with forceps. *e*, The pursestring suture in the bladder is pulled tight. *f*, The pursestring is tied and the bladder is closed in one direction. *g*, The vagina is closed separately.

bowel. The fistula into the bladder was later repaired four times, not in any instance with success for even a few days. When the woman presented herself at the clinic for the first time, there was a vesicovaginal fistula extending from the posterior surface of the symphysis pubis to the anterior lip of the uterine cervix. The fistula was large enough to admit two fingers, and most of the mucosa of the greatly contracted bladder was protruding through it (Fig. 3). There was no urethra. Although the two attempts to close the fistula that were made at the clinic resulted in some diminution in its size, it became apparent that the tissue available was insufficient to effect closure in the usual manner. It was evident, also, that to construct a urethra probably would be impossible, and that control of the flow of urine would not be had even if a urethra could be constructed. Accordingly, the perineum was satisfactorily repaired, and then both ureters were transplanted into the sigmoid, according to the method of Coffey. The patient was allowed to return home 21 days after operation and she is now able to control her urine for as much as 4 hours during the day, and all night.

Case 2. A woman, 47 years of age, presented herself with a large vesicovaginal fistula. Three years before, following subtotal hysterectomy elsewhere for sarcoma which had developed in a fibroid tumor of the uterus, she had been treated with radium. A second application of radium to the uterine cervix was followed by the appearance of a fistula so large that her referring physician felt that the ureters would have to be transplanted. No attempt at repair had been made. When the patient was examined, no recurrence of the malignant growth could be identified, and it was felt that she should not be denied the chance of repair. It was accordingly attempted in the conventional manner. Union was prompt and permanent, and recently she reported that there is no leakage of urine.

Case 3. While a woman, 43 years of age, was still in the hospital following destruction of the endometrium by zinc chloride[1] a large vesicovaginal fistula developed. One month after her first operation an attempt was made to repair the fistula. This was not entirely successful, and diminishing amounts of urine continued to drain by vagina for the next 8 months. When the woman returned to the clinic, cystoscopic examination disclosed a small opening on the left side of the vagina. Repair of the fistula was accomplished, but some urine continued to drain into the vagina, and further examination revealed a second fistula, this one on the right side. Apparently the original repair had resulted in a bridge of tissue, leaving a fistula on each side, the left larger than the right. The opening on the right side was repaired, and then there was no leakage of urine. She now is troubled somewhat by frequency

[1] In this case, and in one of ureterovaginal fistula, occurred the only urinary complications in a series of 188 cases in which the endometrium was destroyed by using a saturated solution of zinc chloride.

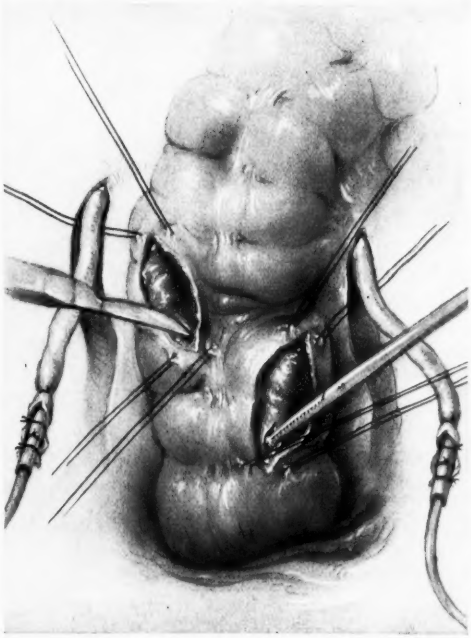

Fig. 2. Transplantation of ureters into the rectosigmoid (after Coffey).

of urination, especially at night, undoubtedly because of the restricted capacity of the bladder.

SUMMARY

It would seem that vesicovaginal fistulas following difficult labor might be allowed a chance to heal spontaneously, but the treatment of most of these fistulas and of all fistulas which follow operative procedures is primarily surgical. Dissection of the tract and inversion of the stump into the bladder, with free separation of the base of the bladder from the anterior vaginal wall, and individual closure of these two structures give the best results. In certain cases in which there is extensive malignancy, this procedure is not practicable, and either the fistula must remain, or both ureters must be transplanted into the sigmoid.

A review of 17 cases in which operation was performed during the last 2 years, revealed complete healing in 12 and diminished drainage in 4. In 1 case, statements in the correspondence were not sufficiently clear to allow estimation of the degree of success.

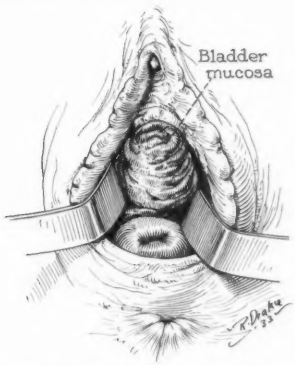

Fig. 3. Large vesicovaginal fistula. The mucosa of the anterior wall of the bladder is seen projecting through the fistula, which extends from the symphysis pubis to the uterine cervix. There is no urethra.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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JUNE, 1934

THE HESITATING SURGEON

ONE of the very last remarks of Sir James Paget to a young associate was: "I have no use for the surgeon with a hesitating sphincter—of the brain." The implication seems to designate a surgeon who is afflicted with a mental tenesmus, who is not quite sure of himself, who is vacillating both in his opinions and in his actions. Such a temperament—for after all the manifestation must be temperamental—does not make for clear cut decision or execution, nor does it allow for the wide advantages of knowledge and training. Actual vacillation is a handicap to a surgeon otherwise endowed with many other excellent qualifications. If, however, the hesitation is due to lack of knowing how, all praise should be given to a conscience-stricken cerebral sphincter, which may cause its possessor to realize that at times it takes more courage to back out than to go ahead.

No surgical procedure should be undertaken in the absence of a well planned and thought out course of action. Yet, in many instances, the exact condition cannot be determined beforehand and, even when a working diagnosis is made, surprises may be in store for those who enter. Here is no place for the hesitating surgeon, but for the surgeon who is resourceful, who can meet situations as they arise, and whose decisions depend upon ripened experience. Once a line of action is chosen, let it go on to completion; this is a good resolution, provided it is founded on recognized surgical principles and comports with the operator's trained judgment. In any event, the operating surgeon is his own best adviser, and the solely responsible factor in the scene. He is most likely to go wrong when he takes some by-stander's advice. If there is one particular thing to be avoided in the operating room, it is a prolonged consultation at the table over the open wound. It is much more reprehensible than talking across the board in a card game.

To condemn hesitation is not to commend rashness. There are surgeons who have a hypertrophied audacity, a boldness, which in itself is a useful talent, but which carried too far leads them to rush in where angels fear to tread. The proper balance is happily held by Guy de Chauliac when he speaks of being "bold in those things that are safe, fearful in those things that are dangerous."

A crude example of the hesitating surgeon is the one who putters around before beginning an operation, fusses along over the automatic details during an operation, fondles the parts overmuch, as if to gain some unseen idea of the next step, and finally finishes the operation with regret, pining for the very joy of continuing. There is no more room left for the hazy surgeon than there is for the so called brilliant operator. Neither can one

justly decry deliberation, or taking time to consider. These are the mainstays of a gracefully performed operation. But, once having decided upon the procedure, all else is to be subordinated to its conduct and its conclusion. Unnecessary manipulations are to be eschewed as leading to clumsy technique as well as being evidence of a hesitating mind. A comedy of errors may be worse than a tragedy of false motions, but in the end the results might be equal. Looking on at the work of a forthright surgeon, master of the job and of himself, one is tempted to use this paraphrase of an old proverb: familiarity breeds repose.

To seek for a judicious balance of head and hand, to pray both for poise and purpose, to strive to be neither cocksure nor wavering, neither reckless nor timid—these are the ideal aims of the successful surgeon. If he who hesitates is lost, he who hurries may also fail.

HUBERT A. ROYSTER.

SURGERY IN THE TREATMENT OF EPILEPSY

THERE are few widespread diseases into the management of which surgery has not penetrated at one time or another, sometimes brilliantly, sometimes blindly and followed by disaster, sometimes even inquisitively. For some time surgery made tentative inroads into the treatment of tuberculosis but at present, with the insight that has been gained into the principles of that disease, it plays an important part in the attack on tuberculosis even of the lungs.

A less successful example is that of spastic paralysis which seemed for a time to come within the grasp of the surgeon. On the basis of a small amount of well conceived but, as it proved, misleading experimental work, and after a few apparently successful sympathectomies, a new cure for this disability was proclaimed around the world and thousands of sympathetic ganglionated chains were sacrificed to easy credulity. Now that this wave of contagious enthusiasm has receded it becomes obvious that the procedure can never be more than an aid to physical therapy in the treatment of that condition although a restricted field has been found in the surgery of certain vasospastic conditions (Leriche, Adson).

Epilepsy, a curse which is as old as the race, has been overtaken by waves of surgical attack. Simple decompressive operations, excisions of a normal motor gyrus, surgical alteration of venous drainage, cauterization of fluid lakes which passively overlay areas of cerebral atrophy, implantation of foreign bodies upon the surface of the brain, varying types of cervical sympathectomy; all of these and many more, such as colectomy, have been employed in the hope of bringing relief to the epileptics whose number on this continent has been estimated by Cobb at half a million.

After these tentative beginnings, what is the status of surgery today in relation to epilepsy? Before an answer can be given to this question the "epilepsies" must be subdivided somewhat on an etiological basis, for it is evident that an epileptic seizure is a common manifestation of many different abnormal conditions which affect the brain. "Epilepsy," Hughlings Jackson said, "is the name for occasional, sudden excessive, rapid and local discharges of grey matter." It is obvious that this discharge may begin in many different parts of the brain even in the cerebral autonomic centers just as in the motor cortex, so that sweating or sudden rise of blood pressure may have a localizing significance on a par with twitching of the extremities.

But it is the cause back of that discharge of grey matter which is first to be considered.

If this cause be tumor the remedial treatment is obviously surgery. Even in the absence of other signs of brain tumor, epileptic seizures appearing for the first time in an adult who gives no history of trauma may well be attributed to this diagnosis until it can be disproved or until some other cause is found.

Trauma may produce in the brain a meningocerebral cicatrix which gives rise to epilepsy and which is susceptible to surgical attack. Such an injury to the brain received either at birth or later may often go unsuspected until the appearance of convulsive seizures. In many cases this traumatic lesion may prove to be so diffuse as to defy surgical intervention from the start. In other cases, however, the lesion is found to be so situated and so delimited as to render complete radical extirpation possible. With these cicatrices may be grouped also certain other non-traumatic, focal lesions of the brain.

In the study of such lesions encephalography is an indispensable aid. Such a scar may exert a pull upon the whole brain through the vaso-astral (vasoglial) framework. It becomes evident in the pneumogram that this cicatrical pull produces a migration of adjacent parts of the ventricle toward the lesion. Further, at operation under local anæsthesia, faradic stimulation of a focal lesion often reproduces what is for the patient a typical seizure. If it be only an aura, a sensory phenomenon, the patient at once identifies it. If it be a convulsion the succession of movements follows his own peculiar pattern.

If finally the patient's history, the encephalogram, the pattern of the seizures and, perhaps, neurological examination all incriminate the same area of the brain then electrical exploration is justified. If this exploration is in accordance with the rest of the evidence complete radical excision of the focal lesion is the rational method of treatment, a treatment which has been justified by its practical results.

But if post-traumatic and neoplastic causes are excluded, we are still faced by an army (the majority alas) of epileptics. What of them? Encephalography will show some to have an unequal atrophy of certain parts of the brain. Others present a diffuse, advanced cerebral atrophy which may be related either to the cause or to the effect of the seizures; while still other sufferers show no more than the slowly progressive cerebral atrophy which one must admit appears in all of us with advancing years.

For these cases of so called "idiopathic epilepsy" there is no approved or accepted surgical procedure. There may never be one although recent work on the innervation of the cerebral vessels has opened a new avenue for study. Contrary to earlier belief cerebral vessels are supplied with nerve fibers both within the pia and within the brain and, furthermore, sympathetic and parasympathetic nervous pathways have been traced to them capable of producing, in the pial vessels at least, visible constriction or dilatation.

These changes which may be produced in normal animals, though definite, are slight in degree when compared with the vascular alterations which are seen in the epileptic brain upon the operating table; for associated with, and subsequent to, epileptic seizures in conscious patients, areas of anæmia, complete arterial constriction, and obvious vascular dilatations occur in cases of habitual epilepsy. These changes have never been seen in normal patients and cannot be reproduced in the experimental laboratory.

Physiological instability of the cerebral blood vessels seems to be the abnormal condition which is common to all cases of epilepsy. The proof of this may be new but the supposition is old, even antedating Hughlings Jackson who said in 1870: "It is, I speculate, through

the arteries that sequence of movements is developed, whether these movements be spasms passing up the arm and down the leg, or whether they be orderly sequences of movements in health."

But, unfortunately, clinical epilepsy is possible in the complete absence of all the sympathetic nerves which enter the cranial cavity in company with the carotid and vertebral arteries. Cervicothoracic sympathectomy is therefore not the answer. Furthermore, experimental epilepsy is possible, according to unpublished work by Gage, after section of the cerebral parasympathetic as well as the sympathetic nerves. Consequently, before attempting to treat idiopathic epilepsy, the surgeon must await further elucidation of the mechanism involved in the discharge, as the physician still looks for further relevation of its ultimate causes. WILDER PENFIELD.

EARLY AMERICAN MEDICAL SCHOOLS

TRANSYLVANIA

DANIEL C. ELKIN, M.D., F.A.C.S., ATLANTA, GEORGIA

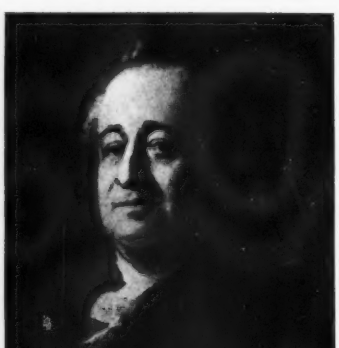
THE struggle for education—a passion among Scotch-Irish settlers—went hand in hand with the struggle for the land in Kentucky and the new west. As early as 1779 we find Joseph Doniphan teaching at Boonesborough, and the year following John McKinney opened a school at Lexington.[1]

In 1780 the State of Virginia placed eight thousand acres of escheated lands of "Kantuckee" county into the hands of thirteen trustees "for the purpose of a public school or a seminary of learning." In 1783 Virginia re-endowed it with twelve thousand additional acres under the name of "Transylvania Seminary." In 1785 a beginning of this seminary was made in a log cabin near Danville, and in 1789 it was located in Lexington, a town already showing promise of becoming the metropolis of the Bluegrass country. Transylvania Seminary, by merging with the "Kentucky Academy" became Transylvania University by act of the General Assembly of Kentucky in 1798, and the year following its trustees instituted the medical department and appointed Dr. Samuel Brown as professor of chemistry, anatomy, and surgery, and Dr. Frederick Ridgely as professor of materia medica, midwifery, and practice of physic. Thus was founded the first medical school west of the Alleghanies, destined because of its faculty, its library, and the number and influence of its students to play an important rôle in the *Winning of the West.*

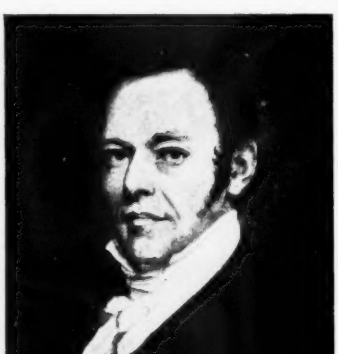
The teaching of students was at first by occasional lectures and by apprenticeship to the professors, and not until 1817 was the first student graduated with the doctor of medicine degree. By that time Benjamin Dudley, professor of anatomy and surgery; James Overton, professor of theory and practice; Daniel Drake, professor of materia medica; William Richardson, professor of obstetrics, and James Blythe, professor of chemistry, had been added to the staff. Charles Caldwell became professor of physiology and the Institutes of Medicine in 1819.

This was a faculty second to none, the country was rapidly growing in population, and by state and private donations an excellent library was added to the school. So it is small wonder that its growth was so rapid that by 1823 there

[1] Harrodsburg, the first settlement in Kentucky, was established in June, 1774. Boone cut the Wilderness Road and built Boonesborough the following year. George Rogers Clark's expedition against Kaskaskia and Vincennes took place in 1778–79. Indian fighting continued in Kentucky as late as 1782 (Bryan's Station and Blue Lick).



Dr. Samuel Brown. (From portrait at Frankfort, by Jouett.)



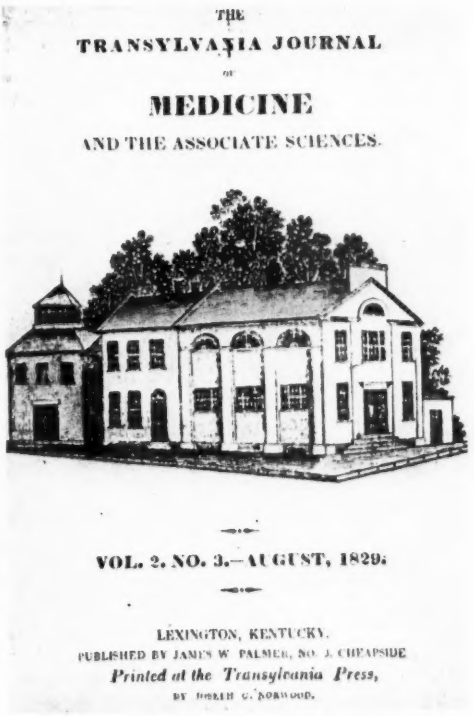
Dr. Benjamin W. Dudley. (From portrait by Jouett, owned by Mrs. Robert Peter.)

were 200 students and 46 graduates. In its 40 years of existence Transylvania enrolled 6,456 medical students and granted its medical degree to 1,881, a record unsurpassed by any school. The academic department kept pace with the medical school, and in 1823, when Jefferson Davis was a student, it had the largest student body in America, and its courses were as advanced as those of Yale or Harvard.

The faculty was widely known because of the numerous publications of its members in medical and scientific journals. Samuel Brown was among the first to accept Jenner's ideas, for as early as 1802 he had vaccinated over five hundred people with cowpox. Aside from his work in medicine, he was a leading geologist and published numerous articles in Silliman's *Journal* and the *American Philosophical Transactions*.

Perhaps more widely known was Brown's successor, Benjamin W. Dudley. He obtained his medical degree at the University of Pennsylvania in 1806 and studied in Europe until 1814 when he settled in Lexington. While abroad he became a member of the Royal College of Surgeons. He was professor of anatomy and surgery at Transylvania until 1850. He excelled as a lithotomist, having performed the operation two hundred and twenty-five times with a mortality of less than 2 per cent. He insisted on the use of *boiled* water in his operations. He wrote voluminously for the *Transylvania Journal of Medicine*, publishing a paper on skull fractures as a cause of epilepsy with five successful trephines for the condition. He was probably the first surgeon in the United States to perform this operation.

A picturesque character and a vital part of the school was Charles Caldwell. Brilliant, polished, eloquent, but vain and egotistical, he had won a place on the faculty of his Alma Mater, the University of Pennsylvania. But his stay there was short lived, for he fell into disrepute with his friend and teacher, Benjamin Rush. Finding the doors of the University of Pennsylvania closed to him, he turned to Transylvania, where he taught the Institutes of Medicine from 1814 to 1837. To Caldwell, more than anyone else, must go the credit for the medical library, the school's most valuable adjunct, and now a notable collection of incunabula and classic first editions. With $13,000 secured from the Kentucky legislature, Caldwell visited Paris in 1820 for the purpose of purchasing books. He writes in his biography: "I found and purchased at reduced prices no inconsiderable number of the choicest works of the fathers of medicine from Hippocrates to the revival of letters. Works which in no other way, and perhaps at no other time, could have been collected so readily and certainly on terms so favorable. . . ." Again in 1839 Dr. Robert Peter, the professor of chemistry, spent in London and Paris $11,000 for books and apparatus.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BY HOBART & NORWOOD.

Title page from the Transylvania Journal of Medicine showing first medical building, erected 1827.

Of equal influence among the early teachers was Daniel Drake, who became professor of materia medica in 1817, but left Lexington the following year to found the Medical College of Ohio at Cincinnati. Due to dissensions in the faculty there, he resumed his chair at Transylvania and became Dean of the Faculty until 1827, when he left again to occupy a similar chair at Jefferson. He was a prolific writer, being editor of the *Western Journal of the Medical and Physical Sciences*, and the author of a two volume medical treatise. He had a great influence on medical education, always insisting upon raising the standards for graduation.

Charles Wilkins Short, because of excellence and originality of his botanical collections (*Shortia*

Galacifolia, *Vesicaria Shortii*, *Aster Shortii*) brought fame and influence to the school, as did Elisha Bartlett, that peripatetic physician who held professional chairs at one time or another in the Berkshire Medical Institute, Dartmouth, Transylvania, Maryland, Vermont, and the College of Physicians and Surgeons in New York.

The decline of Transylvania and its final dissolution was due largely to a shifting population, for Lexington without railroad or water transportation was rapidly giving way to Louisville, on the Ohio, as a metropolis. Nor could Transylvania compete with the rival schools at Louisville and Cincinnati with their greater clinical facilities.

By the year 1850 the number of students had decreased to fifty, and in that year Benjamin Dudley, its most famous teacher, retired. Dissensions in the faculty took some of its best members to the Louisville Medical Institute. "Notwithstanding the efforts of zealous Trustees, notwithstanding the diligence of an able Faculty, the classes steadily decreased from year to year until, in 1857, with only nine graduates, the Faculty in despair disbanded, and the time honored Medical Department of Transylvania University was no more."

The author acknowledges his indebtedness to "The History of the Medical Department of Transylvania," by Dr. Robert Peter, Filson Club Publication, 1905.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE book[1] by Kenneth M. Walker entitled *The Enlarged Prostate and Prostatic Obstruction* is a concise, modern conception of prostatism. The book has been revised because of the recent advances in the treatment of prostatism by transurethral methods. Changes in the prostate and the prostatic age are likened to the climacteric of females.

Although cystoscopy is the best method of exact diagnosis of bladder neck obstruction, it should not always be done because of old age, large residual urines, and general poor risk. The chapter on general treatment of the prostatic is to be highly commended.

The author prefers suprapubic prostatectomy because perineal dissection endangers the rectum and offers poor exposure of the vesical neck. Freyer's technique of a suprapubic prostatectomy is described. Gas and oxygen or sacral anæsthesia should be used. Spinal anæsthesia is particularly liable to invite thrombosis.

True contracture of the vesical neck or prostatic bar are termed dysectasia of the bladder neck.

Transurethral resection is reserved for cases in which the amount of prostatic enlargement is small, or the removal of the prostate gland is contraindicated, or there is carcinomatous obstruction of the vesical neck.

It is emphasized that carcinoma of the prostate gland is not uncommon; this entity should be excluded in all men over 50 years of age, who have difficulty in urination. The value of radium in the treatment of prostatic cancer cannot be exactly evaluated. It is known that the X-ray will alleviate pain in some cases. Cystotomy gives the best relief from obstruction and its concomitant painful cystitis; transurethral resection is used by most workers.

The chances of the prostatic patient in recovering from the operation is something more than 90 per cent and the probability of continued life in entire comfort is over 70 per cent.

Walker's work is considered an excellent treatise on prostatism. HARRY CULVER.

THREE lectures given by Dr. Cannon under the auspices of the Beaumont Foundation of the Wayne County Medical Society, Detroit, Michigan, have been gathered together in a single volume.[2] One of the lectures is on "Thirst and Hunger," another on "The Important Relations of Digestion and Health," and another on "Digestive Disturbances Produced by Pain and Emotional Excitement." The lectures consist of a delightful and authoritative presentation of pertinent subject matter of use in the every day practice of medicine and surgery.

THE subject of emboli has been reviewed by Frey in a very thorough manner. In this monograph[3] of nearly 200 pages, he has presented a graphic and exhaustive description of the pathogenesis of thrombosis and embolism. The German literature has been thoroughly reviewed and there is a well classified bibliography appended to the work.

Blood, fat, air, and foreign body emboli are discussed in considerable detail. The clinical side of the subject has been covered fully but succinctly. About 30 pages are given over to the subject of pulmonary embolism. This part of the work is well illustrated and well organized.

The monograph is written in a style which will interest the student and clinician rather than the research worker in this field. Very little space is given to the question of physical chemistry with which this subject is now suffused.

The diction and sentence structure is sufficiently simple and lucid to enable those not expert in German translation to follow the text with ease and profit.

The monograph is well illustrated and there are a number of very interesting and instructive tables contained in the work. RAYMOND W. MCNEALY.

THE section on tuberculosis of the female genitalia in Veit's *Handbuch der Gynaekologie*[4] is written by Heynemann who discusses, at length, all phases of this disease. The author is definitely against active surgical therapy, is convinced that surgery is passé, and discusses in detail, all forms of light and roentgen therapy. Yet the reader looks in vain for any mention of oxygen pneumoperitoneum, either for diagnosis or therapy. The discussion of climate and altitude is of interest, even though the American reader must disagree with the author's conclusions.

The section on diseases of the pelvic connective tissue by Freund is outstanding. It is simply and

[1] THE ENLARGED PROSTATE AND PROSTATIC OBSTRUCTION. By Kenneth M. Walker, F.R.C.S., M.B., B.C. 2d ed. London: Oxford University Press, 1933.

[2] SOME MODERN EXTENSIONS OF BEAUMONT'S STUDIES ON ALEXIS ST. MARTIN. BEAUMONT FOUNDATION LECTURES. By W. B. Cannon, M.D., S.D., LL.D. Detroit: The Journal of the Michigan State Medical Society, 1933.

[3] DIE EMBOLIE. By Dr. Sigurd Frey. Leipzig: Georg Thieme, 1933.

[4] VEIT'S HANDBUCH DER GYNAEKOLOGIE. Edited by W. Stoeckel. Vol. viii, part 1.—Bauchfellentzuendung Genitaltuberkulose Krankheiten des Beckenbindegewebes. Edited by R. Freund, Th. Heynemann G Linzenmeier. Munich: J. F. Bergmann, 1933.

clearly written, beautifully illustrated, and is a complete monograph on the subject. RALPH A. REIS.

ACUTE and chronic infections of the female genitalia are discussed in part 2 of volume viii of Veit's[1] system on gynecology. The author is Bucura of Vienna, who is well known for his earlier writings on this subject. With the exception of gonorrhœa and tuberculosis, all infections are considered, including the uncommon types of infections such as typhoid, diphtheria, influenza, tetanus, actinomycosis, ecchinococcus, etc.

It is desirable, of course, to include all types of infections in a complete monograph such as this, but a great deal of time, effort, and expense could have been saved by the omission of the long and detailed accounts of the various bacteria and parasites which produce these diseases. After all this is a study primarily of gynecology and not of bacteriology or parasitology.

The discussion of the reticulo-endothelial system is especially praiseworthy, as is the section on hæmatology. The bibliography, is as usual, most complete. This volume is excellently illustrated and stands out in this respect with other volumes of this series which have been previously reviewed. It will prove to be an excellent reference work.

RALPH A. REIS.

IT is surely a valuable contribution to the literature of radiation therapy to have in this single volume[2] by Holthusen a presentation of the historical, physical and biological foundations for accurate dosage measurement in radiation therapy, with chapters on the practical applications and determinations of radiation dosages. It would be a revelation to the average physician to have the opportunity of turning through the pages of this work to gain some slight appreciation of the fact that roentgen and radium dosage measurements are very complicated, requiring much time devoted to study and practice in the various methods available, and proficiency in at least one of the methods. To the physician dealing with practical radiation therapy this work affords a mine of information of a very precise character dealing with the various problems of dosage determination.

JAMES T. CASE.

THE book by Hewer and Sandes[3] is primarily an outline of information concerning the nervous system of man. It is neither a textbook of neuroanatomy nor one of neurophysiology. Although the histological structure of nervous tissues does receive some attention, the book takes as its scope, primarily, the fiber tracts and functional neurological concepts. It contains a great many facts not found in any other single book; these are presented in abridged form. Since most of the subject matter is presented in tables, outlines, and notes which do not make economical use of page space, the size of the volume belies the amount of material it contains. The authors have indulged in extravagant use of simplified colored diagrams of conduction pathways; these occupy unnumbered inserted pages. An appendix of technical methods and an index are to be found at the end of the volume. A few references to the literature appear at the ends of chapters.

WILLIAM F. WINDLE.

[1] VEIT'S HANDBUCH DER GYNAEKOLOGIE. Edited by W. Stoeckel. Vol. viii, part 2.—Die akuten und chronischen Infektionen der Genitalorgane mit Ausnahme der Tuberkulose und Gonorrhoee. By C. Bucura. Munich: J. F. Bergmann, 1933.

[2] GRUNDLAGEN UND PRAXIS DER ROENTGENSTRAHLENDOSIERUNG; DOSISMESSUNG UND DOSISFESTSETZUNG. By Prof. Dr. med. H. Holthusen, in collaboration with Dr. med. R. Braun. Leipzig: Georg Thieme, 1933.

[3] AN INTRODUCTION TO THE STUDY OF THE NERVOUS SYSTEM. By E. E. Hewer, D.Sc. (Lond.), and G. M. Sandes, F.R.C.S. (Eng.), M.B., B.S. (Lond.), 2d ed. London: William Heinemann (Medical Books) Ltd., 1933.

CORRESPONDENCE

A PLEA FOR PROPHYLACTIC INTERVENTION IN THE SECOND STAGE OF LABOR—A Correction

In the May, 1934, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, in the article entitled "A Plea for Prophylactic Intervention in the Second Stage of Labor," by Dr. James Robert Goodall, a typographical error was made in stating the dosage of infundin. In line 13, right column, page 883, the dosage should be 0.5 cubic centimeter.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

WILLIAM D. HAGGARD, Nashville, *President* ROBERT B. GREENOUGH, Boston, *President-Elect*
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PRELIMINARY PROGRAM FOR THE CLINICAL CONGRESS IN BOSTON

THE twenty-fourth annual Clinical Congress of the American College of Surgeons will be held in Boston, October 15–19, 1934. The surgeons of that great medical center have organized under the leadership of a strong and representative committee planning to provide for the Fellows of the College and their guests a program of surgical clinics and demonstrations that will present a most complete showing of their clinical activities in all departments of surgery. The Committee on Arrangements has been assured of the hearty co-operation of the clinicians at the medical schools and more than thirty hospitals that will participate in the clinical program.

In the following pages there is published a preliminary program of clinics and demonstrations as prepared by the Committee on Arrangements. It should be noted that operative clinics and demonstrations in the hospitals are scheduled for the afternoon of Monday, October 15, beginning at 2 o'clock, and for the mornings and afternoons of each of the four following days. The schedules appearing herewith are to be revised and amplified as the work of the program committee progresses during the intervening months. All departments of surgery will be represented in the program—general surgery, gynecology and obstetrics, urology, orthopedics, neurosurgery and surgery of the eye, ear, nose and throat.

Special features of the clinical program include: (1) Demonstrations of modern methods in the treatment of fractures; (2) cancer clinics demonstrating the treatment of cancer by surgery, radium and X-ray; (3) clinics in traumatic surgery demonstrating methods of rehabilitation of injured patients by surgery and physiotherapy.

The following hospitals and schools will participate in the clinical program:

Beth Israel, Evangeline Booth Maternity, Boston City, Boston Dispensary, Boston Lying-In, Peter Bent Brigham, Robert B. Brigham, Cambridge, Cambridge City, Carney, Chelsea, Children's, Faulkner, Free Hospital for Women, Huntington Memorial, Lakeville Sanatorium, Long Island, Malden, Massachusetts Eye and Ear Infirmary, Massachusetts General, Massachusetts Memorial, Massachusetts Women's, New England Baptist, New England Deaconess, New England Hospital for Women and Children, Newton, Palmer Memorial, Peabody Home, Pondville, St. Elizabeth's, State Prison Colony, Symmes Arlington, and Waltham hospitals; Boston University, Harvard University and Tufts College medical schools.

A tentative outline of the programs for a series of five evening sessions as prepared by the Central Executive Committee will be found in the following pages. The first formal session of the Congress, the presidential meeting on Monday evening, will be held in Symphony Hall, at which the president-elect, Dr. Robert B. Greenough, of Boston, will deliver his inaugural address. On that occasion a number of distinguished surgeons from abroad who will be in attendance at the Clinical Congress will be introduced. A feature of the evening will be the John B. Murphy oration in surgery by Dr. Donald C. Balfour. Sessions on Tuesday, Wednesday and Thursday evenings will be held in the ballroom of the Copley-Plaza, at which a number of eminent surgeons of the United States and Canada, together with visiting surgeons from foreign countries, will present papers dealing with surgical subjects of timely importance. The annual Convocation of the College will be held on Friday evening in Symphony Hall at which the 1933 class of candidates will be received into Fellowship in the College.

Special features of this year's Clinical Congress will include: (1) A symposium on cancer under the auspices of the College Committee on the

Treatment of Malignant Diseases on Wednesday afternoon at which further reports by clinicians from various parts of the country will present additional statistics on the cure of cancer. The program will include a series of papers on the treatment of cancer, descriptive of modern methods of treatment and the organization and administration of cancer clinics. (2) A conference on fractures arranged by the College Committee on the Treatment of Fractures on Tuesday afternoon. (3) A conference under the auspices of the Board of Industrial and Traumatic Surgery on Friday afternoon.

On Thursday at 3:30 p.m. following the annual meeting in the ballroom of the Copley-Plaza Hotel a symposium on "Diseases of the Œsophagus" will be presented, as follows:

An X-ray Study on Lesions of the Œsophagus (statistical study with lantern slide demonstration). A. S. MacMillan.

Infection of the Œsophagus in Acute and Chronic Disease; Fibrosis of the Terminal Portion of the Œsophagus (Cardiospasm), Etiology and Treatment. Harris P. Mosher.

The Surgical Approach to the Œsophagus. Edward D. Churchill.

A program of ophthalmological and otolaryngological clinics and demonstrations at the hospitals and medical schools as prepared by the committee in charge of the section on surgery of the eye, ear, nose and throat appears in the preliminary clinical program. In addition, the committee has prepared programs for a series of four sessions on Tuesday, Wednesday, Thursday and Friday afternoons in John Hancock Hall, located on St. James Avenue midway between the Statler and Copley-Plaza Hotels. Distinguished specialists in these branches of surgery will present and discuss papers on subjects of timely interest.

Ether Day will be celebrated at the Massachusetts General Hospital on Tuesday with special exercises at 4 p.m. in the dome room of the old building of the hospital where ether was first administered for the production of surgical anæsthesia on October 16, 1846.

During the Congress surgical motion picture films, both sound and silent, will be exhibited daily in the Georgian Room at the Statler Hotel. The showing of films demonstrating clinical features of interest has met with popular acceptance in recent years. Many new films will be shown at this Congress.

The annual hospital conference will open the Congress with a session in the ballroom of the Copley-Plaza Hotel at 10 o'clock on Monday morning. An interesting program of papers, round table conferences and practical demonstrations dealing with problems related to hospital efficiency is being prepared for sessions to be held on Monday, Tuesday, Wednesday and Thursday mornings in the ballroom of the Copley-Plaza Hotel, with afternoon sessions at several of the hospitals. A greatly increased interest on the part of surgeons in both the administrative and scientific phases of hospital work has been evidenced in recent years and the program for this year's conference will be unique in providing for discussions of subjects of interest to the three major hospital groups—medical, surgical and administrative. The College aims to make this year's program of wide interest and practical character through a careful selection of subjects to be presented and discussed by surgeons and hospital executives, particular emphasis being directed toward professional standards and the vital problems related to medical economics.

Headquarters for the Congress will be established at the Statler and Copley-Plaza Hotels. At the former the grand ballroom and adjacent assembly room, together with other large rooms on the mezzanine floor, have been reserved for registration and clinic ticket bureaus, bulletin boards, exhibits, executive offices, etc., while the ballroom at the Copley-Plaza will be utilized for the evening scientific meetings, hospital conferences and other large gatherings.

The Technical Exhibition will be located in the ballroom and adjoining assembly room at the Statler Hotel. The registration and clinic ticket desk, together with the information bureau, will be located in these rooms in which will also be found the bulletin boards on which the daily clinical programs will be posted each afternoon. The leading manufacturers of surgical instruments, X-ray apparatus, operating room lights, hospital apparatus and supplies of all kinds, ligatures, dressings, pharmaceuticals and publishers of medical books will be represented in this exhibition.

In addition to the two headquarters hotels, the Statler and Copley-Plaza, there are a number of first-class hotels within walking distance of headquarters. Among the hotels recommended by the Committee on Arrangements are the following: Bellevue, Bradford, Brunswick, Buckminster, Graylyn, Kenmore, Lenox, Manger, Parker House, Puritan, Ritz Carlton, Sheraton, Touraine, Victoria and Westminster. While there are ample hotel facilities and there should be no difficulty in securing first-class accommodations, it is advisable for those who expect to attend the Clinical Congress to reserve their accommodations as far in advance as possible.

We are assured that the railways of the United States and Canada will grant low rates for the Clinical Congress in Boston. Applications for reduced fares for this meeting are now pending before the various railway traffic associations.

ADVANCE REGISTRATION

The hospitals and medical schools of Boston afford accommodations for a large number of visiting surgeons, but to insure against overcrowding, attendance at the Congress will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected, therefore, that those surgeons who wish to attend the Clinical Congress in Boston will register in advance.

Admittance to all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

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Scientific Exhibits—Robert B. Greenough, Chairman; Channing C. Simmons, Secretary.

Harvard Medical School Program—David Cheever, Chairman; Magnus I. Gregerson, Secretary.

Publicity—Frederick J. Cotton, Chairman; Gordon Morrison, Secretary.

Entertainment of Foreign Guests—Horace Binney, Chairman; William M. Shedden, Secretary.

Public Meeting—Alexander Begg, Chairman; Dwight O'Hara, Secretary.

Clinical Bulletin—Frank Ober, Chairman.

Ophthalmology and Otolaryngology—George Tobey, Chairman; Lyman Richards, Secretary, Otolaryngology; Theodore L. Terry, Secretary, Ophthalmology.

OPHTHALMOLOGY AND OTOLARYNGOLOGY—SCIENTIFIC SESSIONS

Tuesday—John Hancock Hall, 2—Ophthalmology

JOHN M. WHEELER, New York. Plastic ophthalmic surgery.

JONAS S. FRIEDENWALD, Baltimore. Slit lamp ophthalmoscopy.

CLARENCE KING, Cincinnati. Tuberculin in the treatment of ocular tuberculosis.

Wednesday—John Hancock Hall, 2—Otolaryngology

THOMAS E. CARMODY, Denver. Congenital deformities of the face and neck. Discussion opened by V. H. KAZANJIAN.

LOUIS H. CLERF, Philadelphia. Peroral endoscopy in otolaryngological practice.

SAMUEL J. CROWE, Baltimore. Meniere's symptom complex. Discussion opened by PHILIP MELTZER.

JOHN R. PAGE, New York. Acute infections of the middle ear and mastoid.

O. JASON DIXON, Kansas City. A departure in the management of acute mastoid disease or the advantages of conservative treatment in acute mastoid disease. Discussion opened by LYMAN RICHARDS.

GEORGE M. COATES, Philadelphia. Diagnosis of chronic infection of the tonsils in relation to indications for operation in cases of chronic focal infection.

WILLIAM V. MULLIN, Cleveland. Present status of infection of the upper respiratory tract in its relation to focal infection. Discussion opened by H. ARCHIBALD NISSEN.

EDWARD ZEIGELMAN, San Francisco. The clinical and surgical significance of the component cellular characteristics of the temporal bone, based upon a series of 100 cadaver and autopsy observations, lantern slide demonstration.

Thursday—John Hancock Hall, 2—Ophthalmology

LUTHER C. PETER, Philadelphia. How to treat disturbances of binocular vision by exercises; the use of the stereoscope in the treatment of heterophoria and heterotropia.

CLIFFORD B. WALKER, Los Angeles. The surgical treatment of separated retina.

C. N. SPRATT, Minneapolis. The cataract operation.

Ballroom, Copley-Plaza Hotel—3:30

An X-ray Study on Lesions of the Œsophagus (statistical study with lantern slides). A. S. MACMILLAN.

Infection of the Œsophagus in Acute and Chronic Disease; Fibrosis of the Terminal Portion of the Œsophagus (Cardiospasm), Etiology and Treatment. HARRIS P. MOSHER.

The Surgical Approach to the Œsophagus. EDWARD D. CHURCHILL.

Friday—John Hancock Hall, 2—Otolaryngology

SAMUEL J. KOPETZKY, New York. Recent developments in the diagnosis of meningitis.

WELLS P. EAGLETON, Newark, N. J. Meningitis—result of disease of the petrous apex and sphenoidal basis.

MARVIN F. JONES, New York. Pathways of approach to the petrous pyramid. Discussion by HARRY P. CAHILL.

WILLIAM MITHOEFER, Cincinnati. When and how shall a nasal sinus inflammation be treated nonsurgically?

EDWARD C. SEWELL, San Francisco. Operative treatment of sinusitis, external approach. Discussion opened by CHARLES T. PORTER.

GABRIEL TUCKER, Philadelphia. Cancer of the larynx.

HENRY B. ORTON, Newark, N. J. Cancer of the laryngopharynx. Discussion opened by LEROY A. SCHALL.

SCIENTIFIC EXHIBITS

AT HEADQUARTERS, STATLER HOTEL

FRACTURES. Demonstrating methods of treating fractures, under the anspices of the New England Fracture Committee of the American College of Surgeons.

PLASTIC SURGERY. An exhibit of models, photographs and diagrams, illustrating the different methods employed in plastic surgery and the results.

TRAUMATIC SURGERY. Diagrams, photographs and charts.

ORTHOPEDIC SURGERY. An exhibit of splints and other forms of orthopedic apparatus, together with charts and photographs.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH. An exhibit illustrating the activities of this department.

CANCER. An exhibit from the Palmer Memorial Hospital, Collis P. Huntington Memorial Hospital and the Pondville State Cancer Hospital. Lantern slides, charts and photographs illustrating cancer of the various organs of the body; the diagnosis and the results obtained by different forms of treatment. Also, an exhibit of specimens of cancer from many parts of the body.

OPHTHALMOLOGY. Charts and photographs illustrating melanotic sarcoma and other conditions of the eye.

PATHOLOGY. The specimens removed at operations from the various hospitals in the morning will be collected and placed on exhibition in artificially cooled showcases in the afternoon, in a room adjoining the Georgian Room. At 5 p.m. these specimens will be demonstrated in the Georgian Room by a projectoscope, the microscopic sections shown and the cases discussed.

AT HOSPITALS AND MEDICAL INSTITUTIONS

HARVARD DENTAL SCHOOL. An exhibit of models, photographs and diagrams showing the restoration of extensive defects and deformities of the face and jaws by plastic surgery and dental prosthesis, including cases of soldiers wounded in the world war.

BOSTON MEDICAL LIBRARY. Exhibit of historical books on surgery and anatomy, and surgical medals. Historical pageant illustrating the development of surgery, Wednesday, October 17, John Ware Hall, 4 p.m.; presented by the students of Tufts College Medical School under the direction of Professor B. Spector. Exhibition of works of art by Massachusetts physicians under auspices of the Physicians Art Society.

MASSACHUSETTS GENERAL HOSPITAL. An exhibit in the Ether Dome relative to the first public demonstration of ether anæsthesia. Showing of moving picture "The First Public Demonstration of Ether Anæsthesia."

MASSACHUSETTS CHARITABLE EYE AND EAR INFIRMARY. Anatomical specimens and œsophageal instruments.

HARVARD MEDICAL SCHOOL, Warren Museum. Anatomy, anatomical specimens; pathology, pathological specimens.

PRELIMINARY PROGRAM FOR EVENING MEETINGS

Presidential Meeting—Monday—October 15, 8:15 p.m.

Address of Welcome: ARTHUR W. ALLEN, M.D., Boston, Chairman, Committee on Arrangements

Introduction of Foreign Guests: FRANKLIN H. MARTIN, M.D., Chicago, Director-General

Address of Retiring President: WILLIAM D. HAGGARD, M.D., Nashville, Tenn.

Inauguration of Officers

Inaugural Address. ROBERT B. GREENOUGH, M.D., Boston

John B. Murphy Oration in Surgery. DONALD C. BALFOUR, M.D., Rochester, Minn.

Tuesday—October 16, 8:15 p.m.

Living Grafts of Thyroid and Parathyroid Glands. HARVEY B. STONE, M.D., Baltimore, with the collaboration of JAMES C. OWINGS, M.D., and GEORGE O. GUY, M.D., Baltimore

Endocrinology. EMIL NOVAK, M.D., Baltimore

Wednesday—October 17, 8:15 p.m.

Symposium on Congenital Deformities:

Hydrocephalus and Spina Bifida. WILDER PENFIELD, M.D., Montreal

Congenital Deformities of the Genito-Urinary Tract. HERMAN C. BUMPUS, M.D., Rochester, Minn.

Sterility with Special Reference to Surgical Possibilities. BETHEL SOLOMONS, M.D., F.R.C.P.I., Dublin, Ireland

Diverticulosis and Diverticulitis. IRVIN ABELL, M.D., Louisville

Thursday—October 18, 8:15 p.m.

Symposium on Treatment of Infections:

Infections of Clean Operative Wounds. FRANK L. MELENEY, M.D., New York

Infections of the Lip and Face. FREDERICK A. COLLER, M.D., Ann Arbor, Mich.

Phagedenic Ulcer. EMILE HOLMAN, M.D., San Francisco

The Repair of Defects Resulting from Full Thickness Loss of Skin from Burns. JAMES B. BROWN, M.D., St. Louis

Convocation—Friday—October 19, 8:15 p.m.

Invocation

Presentation of Candidates for Fellowship. FRANKLIN H. MARTIN, M.D., Chicago, Director-General

Conferring of Fellowships. The President

Conferring of Honorary Fellowships. The President

Presidential Address. ROBERT B. GREENOUGH, M.D., Boston

Fellowship Address

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, ORTHOPEDICS, UROLOGY, PROCTOLOGY, SURGICAL PATHOLOGY, ETC.

MASSACHUSETTS GENERAL HOSPITAL

Monday

Staff—2. Dry clinic. A. W. ALLEN: Bleeding peptic ulcer. JOHN STEWART: Water balance in the surgical patient. C. M. JONES: Nutritional œdema. L. S. MCKITTRICK: Cancer of rectum. E. L. YOUNG, JR.: Cancer of colon. J. V. MEIGS and F. W. HOYT: Rupture of Graafian follicle and corpus luteum. R. H. WALLACE: Treatment of burns.

W. J. MIXTER, JOHN HODGSON and associates—2. Neurosurgical clinic.

V. H. KAZANJIAN, E. M. DALAND and associates—2. Plastic surgery clinic.

T. R. GOETHALS and associates—4. Obstetrical clinic.

Tuesday

Staff—9. Operative clinics. General surgical, genito-urinary and thyroid services.

H. C. MARBLE and T. W. HARMER—2. Hand lesions.

GEORGE HOLMES, A. O. HAMPTON and associates—2. Symposium on the roentgen ray.

E. D. CHURCHILL and associates—2. Surgical research laboratories, demonstration of specimens and discussions.

M. N. SMITH-PETERSEN and associates—2. Orthopedic clinic.

Ether Day exercises—4.

Wednesday

Staff—9. Operative clinics, general surgical, fracture and circulatory services.

Staff—2. Dry clinic. D. KING: Postoperative pulmonary complications. H. BRADSHAW: Methods in anæsthesia. H. SPRAGUE: Surgery in cardiac patients. L. S. MCKITTRICK and R. H. MILLER: Ulcerative colitis. E. D. CHURCHILL: Cardiolysis. E. B. BENEDICT: Gastroscopy. R. H. MILLER: Osteomyelitis.

J. V. MEIGS, F. ALLBRIGHT and associates—2. Ovarian dysfunction clinic.

P. D. WILSON, A. W. ALLEN, G. A. LELAND and associates—2. Fracture clinic.

Thursday

E. A. CODMAN and associates—9. Symposium on lesions of the shoulder.

Staff—9. Operative clinics, general surgical and thoracic services.

T. B. MALLORY—12. Clinical pathological conference.

E. D. CHURCHILL, W. WHITTEMORE and associates—2. Thoracic surgery clinic.

A. W. ALLEN and associates—2. Circulatory diseases clinic.

C. C. SIMMONS and associates—2. Tumor clinic; cancer symposium.

Friday

Staff—9. Operative clinics, general surgical and orthopedic services, neurological operations; plastic surgery.

Staff—2. Dry clinic. C. LYONS: Symbiotic infections. B. VINCENT and A. V. BOCK: Surgery of spleen. A. W. ALLEN: Regional ileitis. R. H. MILLER: Tuberculosis of the lymphatic system. R. LINTON: Portal circulation. R. H. SMITHWICK: Significance of negative Graham tests. OLIVER COPE: Subject to be announced. H. ROGERS: Pilonidal sinus.

J. H. MEANS, A. W. ALLEN, E. D. CHURCHILL, R. H. MILLER, E. L. YOUNG, JR. and associates—2. Diseases of the thyroid and parathyroid.

J. D. BARNEY and associates—2. Genito-urinary surgery.

PETER BENT BRIGHAM HOSPITAL

Monday

DAVID CHEEVER—2. Surgical clinic.

H. F. NEWTON—3. Thoracoplasty.

S. A. LEVINE—3:30. Circulatory emergencies in surgical patients.

Tuesday

Staff—9. General surgery, operative clinic.

E. C. CUTLER—2. Total thyroidectomy.

C. L. DERICK—3. Symptoms and diagnosis of vascular thrombosis.

JOHN HOMANS—3:30. Swollen legs.

Wednesday

Staff—9. General surgery, operative clinic.

HENRY A. CHRISTIAN—2. Medical clinic.

M. C. SOSMAN—3. Recent developments in diagnostic radiology.

E. S. EMERY, JR.—3:30. Results of surgical procedures for relief of peptic ulcer.

Thursday

Staff—9. General surgery, operative clinic.

W. C. QUINBY—2. Indications for and results of total cystectomy.

J. C. ECKELS and G. P. GRABFIELD—2:30. Denervated kidney, studied by means of the divided bladder.

M. S. STROCK—3. Methods of fixation of fractures of the jaw.

S. B. WOLBACH—3:30. Demonstration of surgical pathology.

Friday

Staff—9. General surgery, operative clinic.

DAVID CHEEVER—2. Cancer of the stomach.

F. C. NEWTON—2:30. Cancer of the rectum.

R. FITZ—3. Function of the spleen.

W. P. MURPHY—3:30. Treatment of pernicious anæmia, motion picture demonstration.

F. R. OBER—3:45. Treatment of neuromuscular sequelæ of pernicious anæmia.

MASSACHUSETTS WOMEN'S HOSPITAL

Thursday

HENRY T. HUTCHINS—9. Panhysterectomy.

STEPHEN RUSHMORE—9. Plastic laparotomy.

WILLIAM A. WHITE, JR.—9. Laparotomy.

REGINALD MARGESON—9. Transverse cervical Cæsarean section.

ROBERT L. MASON—9. Thyroidectomy.

Staff—2. Dry clinic. CHARLES H. LAWRENCE: Endocrine sterility, end-results. DONALD MACOMBER: Problems of sterility. CHARLES F. PAINTER: Congenital obturator dislocation of right hip; causes of eburnation of bone. J. STEWART ROONEY: Discussion of pathological specimens.

BOSTON CITY HOSPITAL

Monday

Staff—2. Dry clinic. J. J. REGAN, S. WEISS and D. MUNRO: The eye in arteriosclerosis, hypertension and tumor. G. K. COONSE: Treatment of shock. J. RESNIK and M. RITVO: Pellegrini-Steida's disease, diagnosis and treatment. O. J. HERMANN and E. PARKER, JR.: Synovioma of knee. F. A. SLOWICK: Septic hips.

Tuesday

DAVID D. SCANNELL, SOMERS FRASER, THOMAS W. WICKHAM and JOHN A. SETH—9. General surgical dry clinic.

First Surgical Service—9. General surgical operative clinic. HORACE BINNEY: Thoracoplasty for unilateral phthisis; phrenicectomy for unilateral phthisis. JAMES J. HEPBURN: Repair of ventral hernia; gastric ulcer. GEORGE W. PAPEN: Chronic empyema; cholecystitis.

Fifth Surgical Service—2. Dry clinic. IRVING J. WALKER: Some surgical aspects of jaundice—hyperparathyroidism, end-results; repair of common duct; chondrosarcoma of humerus, end-result; carcinoma of stomach, end-result; ligation of common carotid artery, end-result. FRANCIS F. HENDERSON: Carcinoma of lung; pancreatitis, review of sixty cases. AUGUSTUS RILEY: Prostate and vesicles as foci for retroperitoneal infection; kidney resections; demonstration of cases. CHARLES C. LUND: Peripheral arterial embolism, results of operative treatment on fifteen cases. E. EVERETT O'NEIL: Breast tumors, clinical versus X-ray diagnosis. WILLIAM A. WHITE: Subject to be announced.

ROBERT M. GREEN, JOHN T. WILLIAMS, FREDERICK L. GOOD, JOSEPH P. COHEN and associates—2. Gynecological and obstetrical dry clinic: Treatment of miscarriages; puerperal sepsis; pelvic inflammation.

Wednesday

IRVING J. WALKER, FRANCIS F. HENDERSON, CHARLES C. LUND, E. EVERETT O'NEIL and WILLIAM A. WHITE—9. General surgery, operative clinic.

Bone and joint service—9. Dry clinic. OTTO J. HERMANN: Boston City Hospital bone and joint service. THOMAS H. PETERSON: Colles' fracture therapy; Soutter traction in unreduced fractures of the forearm and old shoulder dislocations. GEORGE K. COONSE: Fracture of the olecranon, new operative repair. OTTO J. HERMANN: Recurrent shoulder dislocations repaired by the Nicola method, end-results, discussion. WILLIAM F. COTTING and MARK H. ROGERS: Subdeltoid bursitis. MARK H. ROGERS: Rupture of supraspinatus tendon, discussion. JOSEPH H. SHORTELL: Spinal fracture, therapy. RUSSELL F. SULLIVAN: Spinal fusions. OTTO J. HERMANN: Compound fracture therapy. FRANK W. MARVIN: Anæsthesia in fractures.

First surgical service—2. Dry clinic. NEWTON C. BROWDER: Results of treatment of Colles' fracture; modern splinting methods in fracture therapy. JAMES J. HEPBURN: Results in treatment of peptic ulcer; giant-cell sarcoma of bone; treatment of ventral hernia. HORACE BINNEY: Methods and results in treatment of acute empyema, lung abscess, bronchiectasis, pulmonary tuberculosis. GEORGE W. PAPEN: Methods and results in treatment of chronic empyema.

Sixth surgical service—2. Dry clinic. JAMES W. SEVER: Separation of femoral epiphysis. MARK H. ROGERS: Ankylosed hips. OTTO J. HERMANN: Treatment of intracapsular fractures of neck of femur, demonstration of cases of recent fractures and ununited fractures. FREDERIC J. COTTON: Pelvic fractures. JOSEPH H. SHORTELL: Bone grafting.

ROBERT M. GREEN, JOHN B. WILLIAMS, FREDERICK L. GOOD, JOSEPH P. COHEN and associates—9. Gynecological and obstetrical operations.

Thursday

OTTO J. HERMANN, JOSEPH H. SHORTELL, WILLIAM F. COTTING, RUSSELL F. SULLIVAN, THOMAS H. PETERSON and G. KENNETH COONSE—9. Operative bone and joint clinic. Ward rounds, demonstration of fracture apparatus, etc.

Second surgical service—9. ROBERT C. COCHRANE: Total thyroidectomy for congestive failure and angina; parathyroid tumors. WILLIAM R. MORRISON: One hundred perforated ulcers of the stomach and duodenum from the Boston City Hospital; stomach surgery, motion picture demonstration; demonstration of following casts—total removal of stomach for cancer with anastomosis of the jejunum to the œsophagus, hour-glass deformity of the stomach, cholecysgastrotomy formed by nature. THOMAS K. RICHARDS: Knee-joint pathology. JOHN J. LUCY: Recurrent intussusception caused by intestinal tumor; carcinoma of the sigmoid. RICHARD I. SMITH: Pancreatitis. HERBERT H. HOWARD: End-results of bilateral renal tuberculosis; importance of postoperative treatment of prostatectomized patient.

Fourth surgical service—2. Dry clinic. ARTHUR R. KIMPTON: Civilian gas gangrene; tetanus; use of amniotic liquid concentrate; cavernous hemangioma of neck; catheter in common bile duct since 1926; ununited fractures. EDWARD HARDING: Demonstration of cases. JOSEPH H. BURNETT: Colles' fracture therapy. H. A. BOUVÉ: Acute traumatic abdomen.

Sixth surgical service—2. Bone and joint dry clinic. WILLIAM F. COTTING: Gonorrheal arthritis of the knee. RUSSELL F. SULLIVAN: Hallux valgus therapy. OTTO J. HERMANN: Fractures of the os calcis therapy, discussion. JOSEPH H. SHORTELL: Bone tumors. FREDERICK W. O'BRIEN: Pre- and postoperative X-ray therapy in malignant tumors of the bone. THOMAS H. PETERSON: "Fender" fractures.

ROBERT M. GREEN, JOHN B. WILLIAMS, FREDERICK L. GOOD, JOSEPH P. COHEN and associates—9. Obstetrical and gynecological operations.

Friday

ARTHUR R. KIMPTON, ROBERT C. COCHRANE, WILLIAM R. MORRISON, STEPHEN P. MALLETT and V. H. KAZANJIAN—9. General surgery, operative clinic.

Staff—9. Gynecological and obstetrical operations.

Staff—2. Dry clinic. J. J. REGAN and W. B. CASTLE: The eye in anæmic patients. STEPHEN P. MALLETT: Fractures of the jaw. WILLIAM R. MORRISON: Visualization of arteries and veins for diagnosis and operation of aneurysm; ligation of the first part of right subclavian artery and subsequent ligation of innominate artery for arteriovenous aneurysm of internal jugular vein and subclavian artery. OTTO J. HERMANN and WILLIAM R. MORRISON: Chronic subluxation of sternal end of clavicle. STEPHEN J. MADDOCK: Baer maggot treatment of chronic osteomyelitis.

Physiotherapy service—9. Dry clinic. JOSEPH RESNIK: Electrodiagnosis. JOSEPH RESNIK, GIRDIE W. DICKINSON, ARTHUR J. COLE, WALDO W. ROBBINS and SIDNEY M. SIMONS: Demonstration of cases and treatment.

HARVARD MEDICAL SCHOOL

Monday

G. KENNETH COONSE and OTTO AUFRANC—2 (Bldg. C). Demonstration of the mechanical factors controlling the pulmonary circulation.

CHARLES L. SCUDDER and associates—2 (Bldg. E). Symposium on fractures.

Tuesday

Building D—2

GEORGE B. WISLOCKI. Studies in mammalian reproduction.

VALY MENKIN. Some problems of inflammation related to surgery.

HENRY G. SCHWARTZ. An experimental study of sympathetic reflexes.

J. L. BREMER. The postnatal growth of the mammalian lung.

HAROLD L. WEATHERFORD. The finer changes in the liver cells in anaphylactic shock.

LESTER S. KING. Some aspects of the hæmato-encephalic barrier.

Building E—2

G. A. BENNETT and WALTER BAUER. Joint changes resulting from trauma.

HUGH K. WARD. Streptococcal infections.

CECIL K. DRINKER. The physiology of the lymphatic system and its bearing on certain problems in surgery.

Wednesday

Building C—2

HALLOWELL DAVIS. Effect of cerebral anæmia on the electrical response of the cortex.

M. I. GREGERSEN. The use of hypertonic sucrose solution to reduce cerebrospinal fluid pressure without a secondary rise.

WALTER B. CANNON. Some relations of the sympathetic nervous system to surgery.

Building B—2

DAVID CHEEVER. Surgical anatomy of the abdomen, demonstration on cadaver.

Building E—2

FRANK OBER and associates. Orthopedic problems from Children's Hospital. A. H. BREWSTER: Scoliosis. J. KUHNS: Posture and postural scoliosis. P. NORTON: Posterior transplants. H. FITZSIMMONS: Congenital deformities.

Thursday

CHARLES L. SCUDDER and associates—2 (Bldg. E). Symposium on fractures.

Friday

Symposium on Industrial Surgery—2—Building C

JOHN D. ADAMS and W. A. ROGERS. Injuries of the back.

HENRY MARBLE, F. J. COTTON and J. D. ADAMS. Injuries of the nervous system.

F. J. COTTON and J. H. BURNETT. Colles' fracture.

Orthopedic Clinic—2—Building E

W. GREEN. Osteomyelitis in infants and children.

R. H. MORRIS. Septic hips with involved heads.

A. T. LEGG. Osteomyelitis of the tarsus.

R. JOPLIN. Multiple myeloma.

A. H. BREWSTER. Peroneal spasm.

R. H. MORRIS. Knee flexion.

Daily

Warren Museum—M. Canavan, Curator—2

Demonstration of Dwight collection of spines illustrating deformities, anomalies, diseases. Bone tumors, with X-rays, histories, and microscopic slides, with microscopes available for examination (some of these specimens were used in the illustrations in the monograph on "Bone Sarcoma" issued by the American College of Surgeons). Models showing various types of club feet and effects of operation. Pictures illustrating pathological conditions of bone in Dr. Nichols' collection. Fractures and dislocations of bones as they existed before industrial plants provided so many safeguards. Tuberculosis of bones and joints. Syphilis of bones. Dislocation of ends of bones. Collection of old surgical instruments, obstetrical forceps, turnkeys for extracting teeth, urological tools, cupping and leeching instruments.

BOSTON LYING-IN HOSPITAL

Tuesday and Thursday

FREDERICK C. IRVING and associates—9. Obstetrical operations; demonstrations of premature nursery, X-ray department, research laboratories and hospital wards.

FREDERICK C. IRVING and associates—2. Dry clinic: Fetal roentgenometry; anæmia in pregnancy; treatment of heart disease in pregnancy; treatment of diabetes in pregnancy; management of neglected cases of cephalopelvic disproportion; treatment of placenta prævia; separation of the symphysis pubis; kidney function tests in pregnancy; classification of the albuminuric and hypertensive conditions in pregnancy; factors which make for viability in premature infants; erythroblastosis fetalis; barbiturates and other analgesic drugs in labor.

EVANGELINE BOOTH MATERNITY HOSPITAL

Wednesday

A. K. PAINE, H. S. FINKEL, W. J. MCDONALD, M. G. BERLIN, J. HOPKINS, D. GOLDFARB, A. A. LEVI, J. J. CONWAY, H. BAKER, S. OSGOOD and R. T. PHILLIPS—9. Gynecological operations and obstetrical procedures.

Staff—2. A review by demonstration, charts, pictures and exhibits, of the obstetrical experience of the Booth Hospital: Maternal mortality, factors responsible for the declining rate at the Booth Hospital; the bleeding cases, statistics, management and results; obstetrical sepsis; amnesia, analgesia and anæsthesia in labor, results from the standpoint of safety, efficiency, effects on operative incidence; Cæsarean section, incidence, indications and mortality; toxemia of pregnancy, treatment methods and results over a fourteen year period; "debunking" pelvimetry; heart disease complicated by pregnancy; fetal mortality, analysis of four hundred cases, pathology.

HARVARD UNIVERSITY

(Dillon Field House, Soldier's Field)

Wednesday

AUGUSTUS THORNDIKE, JR.—2. Care and prevention of traumatic injuries in athletics; demonstration of protective strapping, padding and apparatus used in modern athletics.

BETH ISRAEL HOSPITAL

Monday

Staff—2:30. Dry clinic. J. SEARS: Prophylactic vein ligation against embolism from phlebitis of the internal saphenous vein. M. BLOOMBERG: The prevention of scar tissue by use of baudruche, experimental and clinical experiences, demonstration of cases. W. LEVENSON: Intraperitoneal adhesions. L. HERMANSON: Transfusions during active bleeding from peptic ulcer. A. THURMAN: Surgical treatment of cholecystitis. J. MEZER: Subacute pancreatitis. J. FINE: Postoperative distension, an experimental study.

Tuesday

Staff—9. Symposium on total thyroidectomy for chronic heart diseases and angina pectoris. H. BLUMGART: Rationale of total thyroidectomy in chronic heart disease. J. RISEMAN: End-results of total thyroidectomy in angina pectoris. D. DAVID: End-results of total thyroidectomy in congestive heart failure. H. BLUMGART: Indications and contraindications for surgery, selection of cases. C. G. MIXTER: General surgical considerations in total thyroidectomy. D. BERLIN: Technical considerations in total thyroidectomy. DOROTHY GILLIGAN: Postoperative parathyroid tetany. D. DAVIS: Treatment of postoperative complications. J. FINE: A technique for relief of temporary bilateral recurrent nerve injury. A. WEINSTEIN and M. ALTSCHULE: Total thyroidectomy, motion picture demonstration; demonstration of cases.

C. G. MIXTER and associates—2. Surgical operations including total thyroidectomy.

Wednesday

C. G. MIXTER and associates—9. Surgical operations.

Staff—10:30. Dry clinic. W. DAMESHEK: Blood changes in surgical conditions. DR. MORRISON: Medical conditions simulating surgical disease. DR. DEROW: Significance of postoperative rise in nonprotein nitrogen. ARNOLD STARR and DR. MUELLNER: Postoperative renal suppression. C. G. MIXTER: Surgery of the large intestine. S. CARGILL and DR. FALCON-LESSES: Thyroid clinic experiences, demonstration of cases.

E G. CRABTREE and associates—9. Dry clinic, genitourinary surgery. Symposium on the female bladder: Demonstration of various factors related to function in health, pregnancy and disease; use of urethrogram and cystogram in diagnosis of bladder displacements and deformities in the multiparous woman, results of routine surgery; treatment of infections in the abnormal bladder.

Staff—2. Dry clinic. C. BEARSE: Acute appendicitis beyond age of fifty. W. J. MIXTER: Subject to be announced. B. RAPAPORT: Comparison on postoperative complications following spinal and general anæsthesia. J. FINE: Relation of diaphragm to the efficiency of cough. L. NASON: Gas bacillus infection complicating laparotomy. B. BANKS: Differential diagnosis of jaundice. DR. JANKELSON: Indications for ileostomy in ulcerative colitis. C. G. MIXTER: Regional ileitis. M. BARRON: Is radical resection for carcinoma of rectum the best procedure?

Thursday

Staff—9. Symposium on total thyroidectomy for chronic heart disease and angina pectoris. H. BLUMGART: Rationale of total thyroidectomy in chronic heart disease. J. RISEMAN: End-results of total thyroidectomy in angina pectoris. D. DAVIS: End-results of total thyroidectomy in congestive heart failure. H. BLUMGART: Indications and contraindications for surgery, selection of cases. C. G. MIXTER: General surgical considerations in total thyroidectomy. D. BERLIN: Technical considerations in total thyroidectomy. DOROTHY GILLIGAN: Postoperative parathyroid tetany. D. DAVIS: Treatment of postoperative complications. J. FINE: Technique for relief of temporary bilateral recurrent nerve injury. A. WEINSTEIN and M. ALTSCHULE: Total thyroidectomy, motion picture demonstration; demonstration of cases.

C. G. MIXTER and associates—2. Surgical operations including total thyroidectomy.

E. G. CRABTREE and associates—2. Bladder surgery, operative and dry clinic.

Friday

C. G. MIXTER and associates—9. General surgical operations.

W. J. MIXTER—9. Craniotomy.

MARK H. ROGERS and associates—9. Orthopedic dry clinic: Manipulation of subdeltoid bursitis, methods and results; slipping epiphysis, femoral neck; club foot, demonstration of application of plaster cast; method of drainage of septic knees, posterior incision; stenosing tenovaginitis, operative results; Nicola operation, end-results in cases of recurrent dislocation of shoulder; marble bones, repeated fractures of femur; fractures of long bones in Paget's disease; compression fractures of spine in diabetes and old age; correction of hallux valgus, temporary paralysis of sensory nerve affecting the joint.

E. G. CRABTREE and associates—2. Renal surgery.

Staff—2. Symposium on tumors. WILLIAM DAMESHEK: Malignancy of blood forming organs. L. M. FREEDMAN and H. F. FREIDMAN: Laryngeal carcinoma, diagnosis and treatment; presentation of cases. R. DAVIDOFF, C. G. MIXTER and H. F. FREIDMAN: Breast tumors, differential diagnosis, surgical and radiation treatment. DR. SCHLESINGER: Diagnosis of malignancy from ascitic and pleural fluids. H. F. FREIDMAN and R. DAVIDOFF: Policy toward married women in regard to carcinoma of the uterine cervix. S. A. ROBBINS, E. G. CRABTREE and G. E. PRATHER: Renal tumors, roentgen diagnosis, surgical treatment, results. G. E. PRATHER: Testicular tumors. J. H. SCHWARTZ and H. F. FREIDMAN: Carcinoma of the skin, diagnosis, motion picture demonstration of radium treatment.

Daily Exhibit in Medical Research Laboratories

Blood changes in surgical conditions; total thyroidectomy for chronic heart disease; renal function tests in surgery; demonstration of interesting and unusual X-ray films; surgical pathological specimens with case histories, photographs, etc.

STATE PRISON COLONY

Day to be announced

HILBERT DAY. Practice of medicine in a modern correctional institution.

WILFRED BLOOMBERG. Psychiatric approach to prison medicine.

HENRY R. CRAIG. Unusual incidence of peptic ulcer in a prison population.

GEORGE H. LYONS. Minor surgical injuries in a protected population.

GEORGE ROTHBLATT. Dental conditions causing personality changes.

NEW ENGLAND DEACONESS HOSPITAL

Tuesday

F. H. LAHEY, H. M. CLUTE, R. B. CATTELL and R. H. OVERHOLT—9. General surgical operations.

GILBERT HORRAX and JAMES POPPEN—9. Neurosurgical operations.

RICHARD H. OVERHOLT—9. Thoracic surgery operations.

G. E. HAGGART—9. Orthopedic operations.

JAMES B. HICKS—9. Urological operations.

LINCOLN F. SISE, PHILIP D. WOODBRIDGE and URBAN EVERSOLE—9. Anæsthesia.

F. H. LAHEY—9. Œsophageal diverticulum, dry clinic.

GILBERT HORRAX—9. Malignant exophthalmos, dry clinic.

Staff—2. Dry clinics. H. M. CLUTE: Management of obstructive jaundice; exploration of common duct. GILBERT HORRAX: Brain tumors; malignant exophthalmos. SARA M. JORDAN: Gastric cancer and ulcer; gastrojejunal ulcer. F. H. LAHEY: Total gastrectomy for cancer; gastrojejunal colic fistula; surgery of intractable ulcer. EVERETT KIEFER: Hæmorrhage in peptic ulcer. RICHARD B. CATTELL: Embolectomy; parathyroid tetany.

Wednesday

F. H. LAHEY, H. M. CLUTE, R. B. CATTELL and R. H. OVERHOLT—9. General surgical operations.

GILBERT HORRAX and JAMES POPPEN—9. Neurosurgical operations.

RICHARD H. OVERHOLT—9. Thoracic surgery operations.

G. E. HAGGART—9. Orthopedic operations.

JAMES B. HICKS—9. Urological operations.

LINCOLN F. SISE, PHILIP D. WOODBRIDGE and URBAN EVERSOLE—9. Anæsthesia.

Staff—2. Dry clinics: G. E. HAGGART: Subdeltoid bursitis; treatment of flexion deformities. JAMES L. POPPEN: End-results in trigeminal neuralgia; spinal fluid pressure dynamics. FRANK H. LAHEY: Œsophageal diverticulum; hyperthyroidism. H. M. CLUTE: End-results in hyperthyroidism. LEWIS M. HURXTHAL: Thyrocardiac patients. EVERETT KIEFER: Ulcerative colitis. RICHARD B. CATTELL: Surgical treatment of ulcerative colitis. RICHARD OVERHOLT: Limited thoracoplasty in pulmonary tuberculosis; cancer of the lung.

Thursday

E. P. JOSLIN, H. F. ROOT, L. S. MCKITTRICK and T. C. PRATT—9. Surgical and medical diabetic ward rounds.

T. C. PRATT—10:30. Thigh amputation for diabetic gangrene.

L. S. MCKITTRICK—10:30. Gritti-Stokes amputation for diabetic gangrene.

Staff—2. Dry clinic: Surgery in diabetes mellitus. E. P. JOSLIN: Medical care of the surgical patient. L. RICHARDS: Otolaryngological aspect of diabetes. J. H. WAITE: Cataract surgery in diabetes mellitus. Gangrene and infection of the lower extremities: H. F. ROOT, Preventive measures. L. S. MCKITTRICK, Factors influencing the level of amputation. T. C. PRATT, Indications for guillotine amputation. R. S. TITIS: Obstetrics in diabetes. MARK ROGERS: Depressed fracture of the spine in diabetes; subdeltoid bursitis in diabetes mellitus.

Friday

F. H. LAHEY, H. M. CLUTE, R. B. CATTELL and R. H. OVERHOLT—9. General surgical operations.

GILBERT HORRAX and JAMES POPPEN—9. Neurosurgical operations.

RICHARD H. OVERHOLT—9. Thoracic surgery operations.

G. E. HAGGART—9. Orthopedic operations.

JAMES B. HICKS—9. Urological operations.

LINCOLN F. SISE, PHILIP D. WOODBRIDGE and URBAN EVERSOLE—9. Anæsthesia.

Staff—2. Dry clinics. R. B. CATTELL: Cancer of the colon and rectum. GILBERT HORRAX: Root resection for trigeminal neuralgia; cordotomy for pain. JAMES POPPEN: Spinal cord tumors. RICHARD OVERHOLT: Cancer of the breast. JAMES B. HICKS: Transurethral resection of the prostate. H. M. CLUTE: Subphrenic abscess. F. H. LAHEY and FRANK N. ALLAN: Parathyroid tumors.

PALMER MEMORIAL HOSPITAL

Tuesday

Staff—9. Treatment of malignant disease, including surgery, electrosurgery and radium implantation, operative clinic.

Staff—2. Dry clinics. G. A. LELAND: Carcinoma of cervix. FLETCHER COLBY: Urinary tract complications from carcinoma of the cervix. L. S. MCKITTRICK: Interstitial radiation for carcinoma of the breast. R. H. DRESSER: Irradiation of the ovary in cancer of the breast. GEORGE G. SMITH: Diversion of the urinary stream. JOHN HODGSON: Relief of pain in malignant disease.

Wednesday

Staff—9. Treatment of malignant disease including surgery, electrosurgery and radium implantation, operative clinic.

Thursday

Staff—2. Dry clinics. D. F. JONES: Surgical management of carcinoma of the rectum. L. S. MCKITTRICK: Factors favoring early diagnosis of cancer of the colon, principles of treatment. R. H. SWEET: Polyposis of the colon. SHIELDS WARREN: Pathological aspects of rectal polypi. WYMAN RICHARDSON: Blood dyscrasias after gastrectomy and short-circuiting operations on the intestinal tract.

Friday

Staff—9. Treatment of malignant disease including surgery, electrosurgery and radium implantation, operative clinic.

COLLIS P. HUNTINGTON MEMORIAL HOSPITAL

Monday

Staff—2:15. Tumors and diseases of bones, dry clinic. J. C. AUB: Calcium metabolism in diseases of the bones. CHANNING C. SIMMONS: Malignant tumors of bone. RICHARD DRESSER: Radiological diagnosis of bone tumors and certain rare forms of skeletal diseases. C. C. FRANSEEN: The phosphatase determination in bone tumors and skeletal diseases.

GEORGE A. LELAND and J. V. MEIGS—2:15. Carcinoma of the cervix.

Wednesday

Staff—2:15. Carcinoma of the oral mucous membrane, dry clinic. CHANNING C. SIMMONS: Choice of treatment in the individual case. C. C. LUND: Results of treatment of cancer of lip. GRANTLEY W. TAYLOR: Carcinoma of the mouth in the female. RICHARD DRESSER: Radiation treatment of oral cancer. CHARLES B. HOPKINS: Prophylaxis of cancer of the mouth. SOMERS STURGIS: Electrical currents between fillings of different metals as an etiological factor in leucoplakia and cancer of the mouth.

CHANNING C. SIMMONS, GRANTLEY W. TAYLOR and RICHARD DRESSER—2:15. Cancer of the breast.

CHILDREN'S HOSPITAL

Monday

F. R. OBER, W. E. LADD and associates—2. Fractures in children.

Tuesday

F. R. OBER and associates—9. Orthopedic operations.

W. E. LADD—9:30. Plastic repair of harelip and cleft palate, demonstration of cases, motion picture demonstration.

THOMAS H. LANMAN—10. Acute osteomyelitis in infancy and childhood.

PATRICK J. MAHONEY—10:30. The use of various types of skin grafts in children's surgery.

HENRY HUDSON, JR.—11. Acute appendicitis in childhood; Meckel's diverticulum.

Staff—2. Operative clinic, surgery in infants and children.

Staff—2. Orthopedic clinic. A. T. LEGG: Early treatment and the prevention of deformities in poliomyelitis. F. R. OBER: Shoulder operations. J. W. SEVER: Stabilization of the ankle joint. M. KATZEFF: Tendon transplants. A. T. LEGG: Abductor limp.

Wednesday

F. R. OBER and associates—9. Orthopedic clinic at Peabody Home.

Staff—9:30. Operative clinic, surgery in infants and children.

W. E. LADD—2. Congenital hypertrophic pyloric stenosis; intussusception, diagnosis and treatment.

DONALD W. MACCOLLUM—2:30. Treatment of undescended testes, end-results over a 34 year period.

THOMAS H. LANMAN—3. Chronic pulmonary suppuration, demonstration of cases.

HENRY HUDSON, JR.—3:15. Empyema in childhood, its treatment.

SIDNEY FARBER—3:30. Surgical pathology of malignant tumors in infancy and childhood, followed by demonstration of pathological specimens in department of pathology.

EDWARD C. VOGT—3:45. Roentgenological studies of unusual bone tumors in infancy and childhood.

Thursday

F. R. OBER and associates—9. Orthopedic operations.

W. E. LADD—9:30. Intestinal atresia, diagnosis and treatment, demonstration of cases, lantern slide demonstration.

PATRICK J. MAHONEY—10. Types of tracheo-œsophageal fistulæ; differential diagnosis and operative treatment; congenital and acquired œsophageal stricture, demonstration of methods of dilatation.

W. E. LADD—10:30. Atresia of the bile ducts, diagnosis and treatment; choleductus cyst, diagnosis and treatment.

THOMAS H. LANMAN—11. Ureteral transplantation for extrophy of the bladder, demonstration of treated cases.

Staff—2. Operative clinic, surgery in infants and children.

Staff—2. Orthopedic dry clinic. A. H. BREWSTER: Claw feet. F. H. MORRIS: Torticollis, mastoid approach. H. FITZSIMMONS: Discussion. F. R. OBER: Semilunar cartilage. H. FITZSIMMONS: Osteoclasis. R. H. MORRIS: Club feet.

Friday

Staff—9:30. Operative clinic, surgery in infants and children.

Staff—9. Orthopedic clinic. S. M. FITCHET: Cleidocranial dysostosis. F. R. OBER: Shelf operations; Sprengel's deformity. S. M. FITCHET: Flexion deformity of the hips. A. T. LEGG: Coxa plana. J. W. SEVER: Obstetrical paralysis.

W. E. LADD—2. Acute and chronic lymphadenitis, demonstration of cases, lantern slide demonstration.

PATRICK J. MAHONEY—2:30. Treatment of fresh burns.

DONALD W. MACCOLLUM—2:45. Treatment of hemangioma by endothermy, demonstration of cases.

W. E. LADD—3. Surgical significance of pyuria in infancy and childhood, demonstration of cases, lantern slide demonstration.

T. H. LANMAN—3:30. Malignant bladder tumors in childhood.

CAMBRIDGE CITY HOSPITAL

Tuesday

H. H. GERMAIN, D. F. MAHONEY, E. J. O'BRIEN, J. J. MURPHY and E. D'ERRICO—9. General surgical clinic, operative and dry. H. H. GERMAIN: Results in surgery of the shoulder, nerve suture and skin graft following burn; arthroplasty of lower jaw. D. F. MAHONEY: Fracture of pelvis and humerus. E. J. O'BRIEN: Results of transurethral resection of prostate; massive diverticulum in child 2½ years old; results in cases of spina bifida. F. W. O'BRIEN: Traumatic spine and head injuries, demonstration of X-ray films. B. A. GODVIN and WALDO ROBBINS: Orthopedic and fracture clinic.

E. D'ERRICO—2. Injection treatment for varicose veins and ulcers, presentation of cases and motion picture demonstration.

E. DOWNEY—2. Injection treatment of hæmorrhoids, demonstration of cases.

Wednesday

H. H. GERMAIN—9. General surgical operations.

Staff—9. Dry clinic. MAXWELL MACDONALD: Encephalography as an aid to diagnosis in cerebral lesions. F. G. MINITER and T. E. DINAN: Results of accessory sinus operations, demonstration of cases. R. D. YOUNG: Cæsarean section. F. J. LYNCH: Subject to be announced later. J. J. MURPHY: Treatment problems of burns in a general hospital. J. W. ROCKETT: Oral surgery operations. ARTHUR SARGENT and WILLIAM LANNIGAN: Orthopedic and fracture clinic. F. O. O'BRIEN: Traumatic spine and head injuries, demonstration of X-ray films. J. W. ROCKETT and F. MCLEAN: Fractures of lower and upper jaw. M. SHEA: Arthroplasty of lower jaw.

E. J. O'BRIEN and L. ROCKWELL—10:30. General surgical operations.

E. D'ERRICO—2. Acute torsion of great omentum; appendicitis complicating pregnancy.

Thursday

D. F. MAHONEY—9. General surgical operations.

J. J. MURPHY—10:30. General surgical operations. Problem of rupture of urethra, fracture of pelvis, fracture of femur.

F. O. O'BRIEN—11. Traumatic spine and head injuries, demonstration of X-ray films.

CAMBRIDGE HOSPITAL

Tuesday

Staff—9. General surgical clinic, operations and demonstration of cases.

Staff—2. General surgery, dry clinic.

Wednesday

J. W. SEVER and associates—9. Fracture clinic.

V. H. KAZANJIAN—9. Corrective clinic, demonstration of fractures.

Staff—2. Fractures, dry clinic

ST. ELIZABETH'S HOSPITAL

Tuesday

JOSEPH STANTON—9. Subtotal thyroidectomy.
GEORGE KEENAN—9. Hysterectomy.
CHARLES KICKHAM—9. Supravaginal hysterectomy.
E. J. O'BRIEN—9. Transurethral resection of prostate gland.
E. M. HODGKINS—10. Repair of postincisional hernia with peritoneal fascial strips, by utilizing sac.
JOHN SPELLMAN—10. Radical operation for cancer of tongue.
THOMAS BRODERICK—10. Spine fusion.
BENEDICT BOLAND—11. Low transverse cervical section.
LAURENCE LOUIS—11. Total thyroidectomy.
Staff—2. Dry clinic. CHARLES KICKHAM: Series of spontaneous rupture of the uterus. RUSSELL SULLIVAN: End-results of bone and joint problems. LAURENCE LOUIS: Postoperative total thyroidectomy for (a) angina pectoris, (b) congestive heart disease. FRANCIS P. MCCARTHY: Frozen sections; demonstration and discussion of pathological specimens.

Wednesday

JOSEPH STANTON—9. Hysterectomy.
GEORGE KEENAN—9. Cholecystectomy.
RUSSELL SULLIVAN—9. Nikola operation for recurrence of dislocation of shoulder.
LAURENCE LOUIS—9. Radical operation, cancer of breast.
E. J. O'BRIEN—10. Nephrectomy for tuberculous kidney.
WILLIAM MCDONALD—10. Operation for correction of childbirth injury.
THOMAS BRODERICK—10. Reconstruction of hip joint.
M. MCGARTY—10. Removal of cartilage from knee joint.
EDWARD HODGKINS—11. Repair of recurrent inguinal hernia with fascial strips.
MARTIN SPELLMAN—11. Sacro-iliac arthrodesis.
Staff—2. Dry clinic. WILLIAM DOLAN: Industrial surgery. JOHN WHORISKEY: Diseases of the gall bladder, medical cases either refusing operation or being surgically unfit, demonstration of cases. FRANK JANTZEN: Cholecystitis and liver dysfunction (a) with hypopituitary syndrome, (b) with hypothyroid syndrome. MICHAEL MCGARTY: Flap graft in reconstruction of foot. JOHN CASEY: Disease of spleen from a surgical standpoint. THOMAS BRODERICK: Demonstration of spinal cases with operative technique, lantern slides.

Thursday

JOSEPH STANTON—9. Gastro-enterostomy.
BRYANT WETHERELL—9. Nephrectomy.
FRANK JANTZEN—9. Inguinal herniotomy under local anæsthesia.
EDWARD HODGKINS—9. Gastro-enterostomy.
THOMAS BRODERICK—10. Reconstruction of hip joint.
CHARLES KICKHAM—10. Prolapsed uterus with perineal repair and suspension.
WILLIAM DONOVAN—10. Suprapubic prostatectomy.
EDWARD O'BRIEN—10. Suprapubic cystostomy.
MICHAEL MCGARTY—11. Fascial repair of double recurrent inguinal hernia.
BENEDICT BOLAND—11. Tubal plastic for sterility.
Staff—2. Dry clinic. WILLIAM O'HALLORAN: Medicine from a pre-operative and postoperative standpoint. BRYANT WETHERELL: Discussion of diagnosis of carcinoma of bladder. WILLIAM MCDONALD: Polyneuritis in pregnancy. JAMES LYNCH: Vulval phlebitis complicating pregnancy, antenatal. JOSEPH STANTON: Hypocalcemia of unusual origin, gastric ulcer; demonstration of interesting clinical cases.

BOSTON DISPENSARY

Tuesday

Tumor clinic staff—9. Dry clinic. FRANK W. MARVIN: Anæsthesia in operative cases. CHARLES M. PROCTOR: Precancerous and benign lesions of the oral cavity. CHARLES E. DUMAS: Radiation technique in malignancy of the throat. LEROY A. SCHALL: Treatment of cancer of tonsil. GEORGE S. SPEARE: Malignant degeneration of sebaceous cysts. LOUIS E. PHANEUF: Precancerous lesions and cancer of the cervix, lantern slide demonstration. ALICE ETTINGER: Early diagnosis of malignancy of gastro-intestinal tract by relief method. HAROLD A. CHAMBERLIN: Papillary tumors of the kidney pelvis. ROGER C. GRAVES: Management of cancer of penis with particular reference to a modified operation for advanced cases. MYRON J. HAHN: Cancer of the prostatic capsule. ISADORE OLEF: Management of malignancy of the lymphatic system. HILBERT F. DAY: Cancer of breast, end-results of dispensary and personal cases. JOEL ROSENBERG: Bleeding carcinoma of breast without tumor. WILLIAM M. SHEDDEN: Management of cancer of rectum with particular reference to irradiation. HAROLD MCMAHON: Relation of pathology department to tumor clinic.

Wednesday

Staff—10. Dry clinic. OLIVER G. TINKHAM: Clinical teaching of third year medical students. FRANCIS P. BARNUM: Use of adhesive plaster. P. A. CONSALES: Adenomatous changes in aberrant thyroid. HILBERT F. DAY: Management of a varicose vein clinic, where over 150 treatments a week are given. EDWARD T. WHITNEY: Varicose ulcers, demonstration of cases and treatment. WALTER S. LEVENSON: High ligation of varicose veins. WILLIAM M. SANTORO: Injection treatment of varicoceles. S. SEYMOUR HORLICK: Results of multiple injections of varicose veins at same visit. HILBERT F. DAY: Results of excision of sloughs following injection treatment.

Thursday

Staff—9. Dry clinic. JOHN D. ADAMS: Shueller-Christian disease (xanthomatosis); bone tumors. ROY E. MABREY: Chordoma and chondrosarcoma. WILLIAM A. HINTON: Detection of syphilis as an aid in practice of surgery. FRANCIS M. THURMON: Syphilis and the differential diagnosis of surgical conditions. JOSEPH SKIRBALL: Ophthalmic studies in syphilis. GRACE E. ROCHFORD: An unusual gynecological condition. LOUIS A. O. GODDU: Pain in the shoulder girdle. ROBERT W. BUCK: Kidney function; renal function tests. WILLIAM E. DAVIS: Some observations in treatment of peptic ulcer in out-patient clinic. ALICE ETTINGER: Diagnosis of activity of duodenal ulcer by X-ray. KATHERINE S. ANDREWS: Hiatus hernias. HILBERT F. DAY: Solitary gallstone pain relieved by posture. Demonstration of interesting X-ray plates of peptic ulcer and gall-bladder disease.

SYMMES ARLINGTON HOSPITAL

Tuesday

F. J. COTTON—9. Bone and joint surgery.
A. L. BRETT—9. Tumor of the spinal cord; shoulder arthrodesis.
G. P. TOWLE—9. General surgery.
S. G. JONES—9. Volkmann's paralysis.

NEWTON HOSPITAL

Tuesday

E. D. LEONARD—9. Breast amputation.
G. M. MORRISON—9. Reconstruction of elbow.
G. K. COONSE—9. Operative treatment of fractured patellæ.
E. G. CRABTREE—9. Cystotomy.
F. W. MARVIN—9. Pantocain anæsthesia.
D. G. NUTTER—9:15. Desmoid cysts of the abdomen.
R. I. SMITH—9:30. Carcinoma of the duodenum.
G. C. PRATHER—9:30. Renal calculus.
N. P. BRACKETT—10. Strangulated hernia in the aged.
D. G. NUTTER—10. Hysterectomy for fibroids.
G. K. COONSE—10. Triceps repair of olecranon fracture.
G. M. MORRISON—10. Ankle fractures.
F. R. CLARK—10. Cæsarean section.
H. WATTERS—10:15. Intussusception in infancy.
D. G. WILCOX—10:30. Pyosalpinx.
E. D. LEONARD—10:45. Paralytic ileus.
R. I. SMITH—11. Complete thyroidectomy for angina pectoris.
N. P. BRACKETT—11. Cholecystectomy.
H. G. DUNPHY—11. Ligation of saphenous vein for varicose ulcer.
Fracture and Orthopedic services—9. Dry clinic: Demonstration of application of plaster casts, Boehler technique; application of Anderson well leg traction apparatus; treatment of fractures of the spine, including hyperextension, frames, jackets, etc.; treatment of Colles fracture by Cotton-Loder method; demonstration of new type humeral traction abduction splint.
Staff—2. Symposium on obstetrics: E. GRANVILLE CRABTREE: Discussion of urinary tract infection in pregnancy. GEORGE C. PRATHER: Discussion of lone kidneys in pregnancy. F. R. CLARK, M. F. EADES and G. E. MAY: Pre- and postoperative care of patients and complications.
ROBERT G. VANCE—2. X-rays of traumatic skulls.

FAULKNER HOSPITAL

Wednesday

F. J. COTTON, E. G. BRACKETT and associates—9. Bone and joint clinic, operative and dry.
Staff—2. Dry clinic. E. G. BRACKETT: Hip fracture. F. J. COTTON: Bone tumors; fractures of pelvis. H. C. MARBLE: Hand surgery; fractures of the forearm. J. D. ADAMS: Industrial lesions of the knee. WILLIAM A. ROGERS: Compression fracture of spine. E. A. CODMAN: Shoulder lesions. B. GODVIN: Os calcis fractures. W. F. CÖTTING: Ankle fractures.

Thursday

E. L. YOUNG, JR., R. C. COCHRANE, A. R. KIMPTON and associates—9. Operative clinic.
J. R. TORBERT and R. S. TITUS—11. Obstetrical clinic.
S. W. WIGGIN—11. Postoperative pulmonary complications.
Staff—2. Dry clinic. H. L. JOHNSON: Amfetin. E. L. YOUNG, JR.: Immunity in peritoneal cavity. R. C. COCHRANE: Total thyroidectomy. F. G. BALCH, JR.: Injection treatment of hæmorrhoids. H. K. SOWLES: Elbow fractures. Demonstration of X-ray plates and pathological specimens.

MASSACHUSETTS MEMORIAL HOSPITAL

Daily

Staff—9. Operative clinics
Staff—2. Dry clinics.

FREE HOSPITAL FOR WOMEN

Tuesday

F. A. PEMBERTON, G. V. SMITH and S. C. GRAVES—9. Operative and dry clinic: Carcinoma of cervix uteri, treatment and results, prevention, diagnosis of early cases, relation to cervicitis and its treatment, complications of radium treatment, relief of pain; carcinoma of fundus uteri, treatment and results, classification; other tumors of uterus, fibroids, adenomyoma.

Wednesday

F. A. PEMBERTON, G. V. SMITH and PAUL YOUNGE—9. Operative and dry clinic: Tumors of the ovary, diagnosis, treatment and results. Cyst adenoma, granulosa cell tumor, Brenner tumor, teratoma; endometriosis, diagnosis and treatment; tumors of tubes, round ligaments and vagina.

Thursday

G. V. SMITH and JOHN ROCK—9. Operative and dry clinic: Sterility, diagnosis, treatment and results; menorrhagia and metrorrhagia, diagnosis, treatment and results; developments in endocrine research; dysmenorrhea.

Friday

F. A. PEMBERTON, E. B. SHEEHAN and S. C. GRAVES—9. Operative and dry clinic: Prolapse, procidentia; complete tear of perineum; vesico- and rectovaginal fistulæ; kraurosis vulvæ, carcinoma vulvæ; trichomonas vaginale; tumors of breast, value of X-ray treatment.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Tuesday

Staff—9. Surgical operations.
Staff—2. Dry clinic: Carcinoma of fundus in young woman treated for amenorrhea with antuitrin-S; fibrosarcoma of liver in six year old child; carcinoma of kidney with metastasis in three year old child; unusual pathological specimens with case histories.

Wednesday

Staff—9. Surgical operations.
Staff—9. Obstetrical analgesia with demonstration of cases; ward rounds; prenatal clinic; parent-teaching clinic.

Thursday

Staff—9. Surgical operations.
Staff—9. Orthopedic operations; demonstration of unusual case of fractured pelvis.
MIRIAM KATZEFF—9. Familial muscular dystrophy.

Friday

Staff—9. Surgical operations.

CARNEY HOSPITAL

Daily

F. B. LUND and associates—9. General surgical operations.
L. E. PHANEUF and associates—9. Gynecological and obstetrical operations.
W. R. MACAUSLAND and associates—9. Orthopedic operations.
R. S. GRAVES and associates—9. Urological operations.
Staff—2:15. Dry clinics.

ROBERT B. BRIGHAM HOSPITAL

Monday

L. M. SPEAR—2. Classification of types of arthritis.
L. T. SWAIM and J. KUHNS—3. Treatment and orthopedic principles involved in arthritis.

Tuesday

H. K. THOMPSON—2. Clinical analysis of arthritis with reference to classification and treatment.
P. D. WILSON and S. ROBERTS—3. Discussion of operative procedures, demonstration of end-results.

Wednesday

L. M. SPEAR—2. Classification of types of arthritis.
L. T. SWAIM and J. KUHNS—3. Treatment and orthopedic principles involved in arthritis.

Thursday

H. K. THOMPSON—2. Clinical analysis of arthritis with reference to classification and treatment.
P. D. WILSON and S. ROBERTS—3. Discussion of operative procedures, demonstration of end-results.

MALDEN HOSPITAL

Wednesday

L. E. PHANEUF and N. A. GALLAGHER—9. Gynecological operations.
R. SULLIVAN—9. Orthopedic clinic.
L. W. MCQUIRE—9. Amebic dysentery and its complications.
C. F. LYNCH, D. J. DUGGAN, I. J. WALKER and F. W. GAY—2. Surgical operations.
Staff—2. Dry clinic. J. S. ROONEY: Pathological demonstration. I. J. WALKER: Discussion of jaundice with demonstration of liver specimens. L. SILVA: Discussion of coronary and gall-bladder disease in middle-aged people with electrocardiographic tracings. C. H. STAPLES: Hyperpituitarism with demonstration of cases.

PONDVILLE STATE CANCER HOSPITAL

Tuesday—2 p.m.

ERNEST M. DALAND. The Massachusetts cancer program.
HENRY JACKSON, JR. Some aspects of malignant lymphoma.
JOE V. MEIGS. Ovarian tumors.
LANGDON PARSONS. Treatmeht of cancer of the cervix by X-ray followed by radium.
ROGER GRAVES. Cancer of the prostate with metastases.
CHARLES KICKHAM. Cancer of the penis.

Friday—2 p.m.

GRANTLEY TAYLOR. Radium needles in cancer of breast.
HORATIO ROGERS. Chronic cystic mastitis.
RICHARD DRESSER. X-ray in the diagnosis of gastro-intestinal cancer.
SHIELDS WARREN. Changes in tumor tissue caused by radiation.
JOHN HODGSON. Treatment of pain in cancer patients.
CARL ERNLUND. Cancer of the antrum.

WALTHAM HOSPITAL

Friday

R. L. DENORMANDIE, T. W. HARMER, D. MUNRO, J. D. BARNEY, J. W. SEVER, H. Q. GALLUPE, R. COLLINS and H. A. WOOD—9. Surgical operations.
R. L. DENORMANDIE, T. W. HARMER, D. MUNRO, J. D. BARNEY, J. W. SEVER, H. Q. GALLUPE, R. COLLINS and H. A. WOOD—2. Dry clinics: General surgery, orthopedics, obstetrics, pathology, etc.

NEW ENGLAND BAPTIST HOSPITAL

Tuesday

HALSEY B. LODER—9. Operative clinic.
Staff—9. Dry clinics. HALSEY B. LODER: Portal thrombosis; ulcerative colitis; gall stones, pancreatitis; uterine fibroids. A. A. HORNOR: Ulcerative colitis. ROBERT L. DENORMANDIE and DELOS J. BRISTOL: Blood transfusion in obstetrics; management of borderline obstetrical cases; anæsthesia and analgesia in obstetrics; prevention of eclampsia.

Thursday

F. H. LAHEY, H. M. CLUTE, R. B. CATTELL and R. H. OVERHOLT—9. General surgery, operative clinic.
GILBERT HORRAX and JAMES POPPEN—9. Neurosurgical operations.
G. E. HAGGART—9. Orthopedic surgery.
JAMES B. HICKS—9. Urological surgery.
LINCOLN F. SISE, PHILIP D. WOODBRIDGE and URBAN EVERSOLE—9. Anæsthesia.

CHELSEA MEMORIAL HOSPITAL

Thursday

Staff—9. Dry clinic. CHARLES P. SHELDON: Septic abortions. LLEWELLYN H. ROCKWELL: Perforated duodenal ulcer. GEORGE A. MARKS: Acute appendicitis with peritonitis. SYLVESTER B. KELLEY: Causes of death in prostatitis.
Staff—2. General surgical operations.
Staff—2. Dry clinic. GORDON MORRISON: Abdominal trauma. G. STEPHEN JONES: Volkmann's contracture. ALEXANDER P. AITKEN: Epiphyseal separation of the radius. JOHN S. HODGSON: Fractures of the skull. Discussion by FREDERICK J. COTTON.

LONG ISLAND HOSPITAL

Wednesday

R. H. MORRIS and T. H. PETERSON—9. Fracture demonstration.
H. R. VIETS—9. Neurosurgical diagnosis.
J. H. CUNNINGHAM and C. S. SWAN—9. Urological operations.
A. S. MACMILLAN—2. X-ray demonstration.
I. B. AKERSON—2. Pathological demonstration.
C. L. SWAN, R. I. SMITH and T. C. PRATT—2. General surgical operations.

LAKEVILLE SANATORIUM

Wednesday

Z. B. ADAMS—9:30. Ankylosis of hip, operative. Ward rounds.
Staff—2. Dry clinic: Tuberculosis of lymph nodes, genito-urinary tract, eye, gastro-intestinal tract, peritoneum, and skin.
Z. B. ADAMS—2. Orthopedic dry clinic.

INDUSTRIAL SURGERY

Tuesday

H. C. MARBLE and H. P. TOWLE (142 Berkeley Street)—9.
D. LYNCH and B. GODVIN (245 State Street)—9.

Wednesday

G. W. MORSE (31 St. James Avenue)—9.

Thursday

WILLIAM DOLAN (110 Milk Street)—9.

Friday

J. H. SHORTELL (260 Tremont Street)—9.
D. LYNCH and B. GODVIN (245 State Street)—9.

SURGERY OF THE EYE, EAR, NOSE AND THROAT

MASSACHUSETTS EYE AND EAR INFIRMARY

OPHTHALMOLOGICAL SECTION

Monday

Staff—2. Ophthalmological operations.
VIRGIL G. CASTEN—2. Visual fields in neurological cases.
T. L. TERRY—2. Pathological demonstrations.

Tuesday

H. B. C. RIEMER and assistant—9. Ophthalmological operations.
DR. BEDELL—9. Technique of photographing the fundus.
F. H. VERHOEFF and assistant—9. Ophthalmological clinic.

Wednesday

J. HERBERT WAITE and assistant—9. Ophthalmological operations.
DR. BEDELL—9. Technique of photographing the fundus.
F. H. VERHOEFF and assistant—9. Ophthalmological clinic.
ALLEN GREENWOOD—2. Fundus cases.
T. L. TERRY—2. Pathological demonstration.
Staff—2. Ophthalmological operations. Motion pictures of operations.

Thursday

EDWARD K. ELLIS and assistant—9. Ophthalmological operations.
H. B. C. RIEMER—9. External diseases of the eye.
J. J. DUNPHY—2. Traumatic injuries, methods of treatment and results.

Friday

W. HOLBROOK LOWELL and assistant—9. Ophthalmological operations.
DR. MCCARTHY—9. Color vision testing.
VIRGIL G. CASTEN—2. Ocular paralysis in neurological cases.
T. L. TERRY—2. Pathological demonstration.
Staff—2. Ophthalmological operations.

OTOLARYNGOLOGICAL SECTION

Staff—9, daily. Operations and demonstration of cases.

Dry Clinic—Friday, 2.

H. P. CAHILL. The present status of brain abscess from the standpoint of the otologist.
P. E. MELTZER. A twelve year summary of cases of lateral sinus thrombosis at the Infirmary.
P. MYSEL. A ten year review of cases of labyrinthitis at the Infirmary.
D. C. SMYTH. Chest cases requiring bronchoscopy, lantern slide demonstration.
A. S. MACMILLAN and D. C. SMYTH. The accessory sinuses from the standpoint of the roentgenologist and the clinician.
A. S. MACMILLAN. Petrositis from the X-ray standpoint.
G. H. POIRIER. Result of the Mosher-Toti tear sac operation.
M. H. LURIE. Histological slides showing the pathological condition of the internal ear.
E. W. HERMAN. Radium and X-ray treatment of cancer of the larynx.
H. P. MOSHER. Notes on œsophageal cases.
F. E. GARLAND. Surgery of the submaxillary gland.
C. G. PAGE. Fungi in tracheal and bronchial mucous.
G. L. TOBEY, JR. The Tobey-Ayer test.

HARVARD MEDICAL SCHOOL

Monday

H. DAVIS, H. A. DERBYSHIRE and M. H. LURIE—3 (Bldg. C). Demonstration of auditory experiments on the cat—response to sound in the cochlea, response to sound in auditory nerve and nerve pathways in the brain.

Tuesday

H. P. MOSHER—2 (Bldg. B). Exhibition of anatomical casts demonstrating the anatomy of the nose and throat, discussion of teaching methods; demonstration on the cadaver of the submaxillary approach for deep pus in the neck.
P. E. MELTZER and M. H. LURIE. Exhibition of specimens illustrating the anatomy of the ear.

Daily demonstration

F. E. GARLAND (Bldg. B). Demonstration of historical instruments.

NEW ENGLAND DEACONESS HOSPITAL

Monday

J. H. WAITE and associate—2. The eye in diabetes.

Tuesday

WALTER B. HOOVER—9. Osteoma of sinuses; laryngeal and tracheal complications of thyroid surgery; lingual tonsils and lateral bands of pharyngeal lymphoid tissue; syndrome of anæmia, glossitis and dysphasia.
J. H. WAITE and associate—2. The eye in thyroid.

Wednesday

WALTER B. HOOVER—9. Ear, nose and throat operations.

Friday

WALTER B. HOOVER—9. Ear, nose and throat operations.

BETH ISRAEL HOSPITAL

Tuesday

Staff—2. Otolaryngological clinic. L. M. FREEDMAN: Experiences with vocal cord paralysis in thyroidectomy. D. J. FINE: Technique for relief of bilateral recurrent nerve injury. CHARLES GETTES: Studies on galvanism in vestibular tests. L. M. FREEDMAN: Jugular puncture in mastoiditis. S. CLINE: Tuberculous laryngitis and its treatment. S. GARFIN: Treatment of malignant tumors of the upper respiratory tract. L. M. FREEDMAN: Bronchoscopic studies.

Thursday

DRS. LIEBMAN and SACHS—10. Eye clinic: Cataract extraction, muscle advancement. Demonstration of cases.

FAULKNER HOSPITAL

Thursday

C. FAUNCE—11. Nose and throat clinic.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

ISABELLA D. KERR. The use of avertin anæsthesia in tonsillectomies.
MARGARET NOYES KLEINERT. Mastoidectomies in infants.

MASSACHUSETTS MEMORIAL HOSPITAL

Tuesday

WILLIAM D. ROWLAND—9. Ophthalmological operations.

Thursday

Staff—2. Ophthalmological clinic.

Days to be announced

L. F. JOHNSON. Bronchoscopic operative clinic.
C. W. BUSH, R. O. PARRIS and B. N. WEIN. Otolaryngological operations.
H. L. BABCOCK. Otological problems in contagious diseases.
A. W. ROWE and D. W. DRURY. Endocrine factors in deafness.

BOSTON CITY HOSPITAL

Monday

J. J. REGAN, SOMA WEISS and DONALD MUNRO—3:10. The eye in arteriosclerosis, hypertension and tumor.

Thursday

J. J. REGAN and DONALD MUNRO—2. Neurological cases, dry clinic.

Friday

J. J. REGAN and staff—9. Ophthalmological operations.
J. J. REGAN and WILLIAM B. CASTLE—2. The eye in anæmic patients.

BOSTON DISPENSARY

Wednesday

HARRY J. INGLIS and associates—9. Dry clinic. LOUIS WOLFSON: Bronchoscopy in the upright position as an out-patient procedure. A. I. COHEN, F. S. DUSHAN and FRANCIS STERN: An improved method of skin testing in allergic disturbances of nose and throat.
Staff—9. The eye and syphilis.

NEWTON HOSPITAL

OLIVER A. LOTHROP. Tonsil, sinus and septum operations; reduction of recent fractures of the malar and nasal bones; discussion of the indications for mastoid and sinus surgery.
CHARLES I. JOHNSON, DONALD H. MACDONALD and EDGAR M. HOLMES. Ear, nose and throat operations, demonstration of cases.

NEW ENGLAND BAPTIST HOSPITAL

Thursday

WALTER B. HOOVER—9. Ear, nose and throat operations.

ST. ELIZABETH'S HOSPITAL

Tuesday

WILLIAM T. HALEY—11. Operation for correction of dislocation of nasal septum.
PETER MCADAMS—11. Surgery of the eye.

Wednesday

JOHN BURNS—11. Radical sinus operation under nerve block.
HUGH DONAHUE—11. Operation for cataract.

Thursday

WILLIAM T. HALEY—11. Radical operation for maxillary antrum.
JOHN BURNS—11. Radical mastoid operation.

CHILDREN'S HOSPITAL

Wednesday

Staff—9. Otolaryngological clinic. LYMAN RICHARDS: Acute laryngo-tracheo bronchitis. MAURICE EVANS: Bilateral jugular ligation and its neurological complications. PHILIP MYSEL: Cerebral abscess in children. CHESTER MILLS: Sinusitis in children. JOSIAH E. QUINCY: Radical mastoid operation in children. CHARLES ALLMAN: Unusual foreign bodies. ELMER GILLESPIE: Complications in simple mastoidectomy. SAMUEL CLINE: Some cases of sinus thrombosis.

CAMBRIDGE HOSPITAL

Thursday

E. J. BUTLER and C. H. ALLMAN—9. Ear, nose and throat clinic, operative and dry. Hematogenous infection of left mastoid with extradural abscess in a nine months old child; pneumococcus type III meningitis with labyrinthitis, demonstration of case.

CARNEY HOSPITAL

Daily

EDWARD D. HURLEY and associates—9. Ophthalmological clinics.
F. G. MINITER and associates—9. Otolaryngological clinics.

CAMBRIDGE CITY HOSPITAL

Tuesday

J. W. ROCKETT and T. E. DINAN—9. Tonsillectomies with gas-oxygen anæsthesia; presentation of cases of lateral sinus thrombosis.

LONG ISLAND HOSPITAL

Tuesday

V. G. CASTEN—2. Ophthalmological operations.

APR - 3 1934

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Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

Official Journal of the American College of Surgeons

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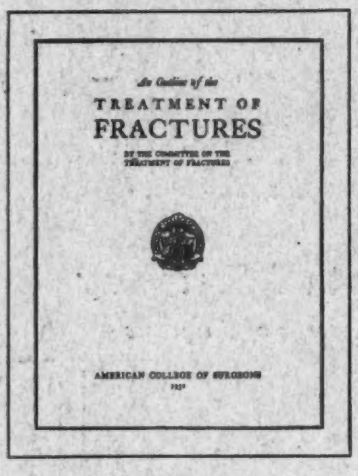

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